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Correspondence.—Wishing to make this Journal a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of these subjects a pleasure or a profession.

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[OFFICIAL NOTICE.]

American Gas Light Association.

OFFICE AMERICAN GAS LIGHT ASSOCIATION,
142 CHAMBERS STREET, NEW YORK.

To the Members of the Association:

The Ninth Annual Meeting of the American Gas Light Association will be held in Boston, on Wednesday, Oct. 19th, and continue for three days.

Members of the Association are earnestly requested to prepare papers upon the many topics of general interest, to be read at that meeting. The Secretary counts upon the active co-operation of the members in his efforts to render the meeting of marked value.

WM. HENRY WHITE,
Secretary.

THE CENSUS OF THE GAS INDUSTRY.

Most of the returns from the gas companies have been made, but there is still a number of companies that have not complied with the request of the special agent, and delay sending in their statements. It is consequently impossible to complete the compilation as the few returns due prevent it.

We would, therefore, respectfully and urgently request the companies not yet having attended to this matter to give it early attention.

ASSOCIATIONS FOR THE ADVANCEMENT OF GAS LIGHTING.

It is not many years since it was generally, but not universally, considered one of the fundamental principles of the gas industry to so carry on the operations of a company that no one, outside the management, should know how, or with what results, the manufacture and distribution were conducted. If an improvement was contemplated, or in use, it was for the benefit of the company introducing it, not for others; if others wanted to progress it must be done at their own risk, and from their own experience, assisted, more or less, by the comparatively scant literature referring to the gas lighting of the past. It was not difficult to find the gas manager of the old school who considered that his methods were the only true ones, and that his knowledge included the whole domain of the science and art of the industry. He remained satisfied in his convictions because there was little mutual confidence between manufacturers, and the opportunities for intelligent investigation, comparison and contradiction were few, or impossible.

Wasteful working, extravagant expenditure, illy-designed plant, large losses by leakage, were permitted in those days, when comparative statements of working results could hardly be obtained. Moreover our present great competitor kerosene was then selling at five or six times its present price, and an extra charge to the consumer may, in some cases, have been necessarily made to return dividends that might have been obtained by the savings resulting from improved working.

The need of a change was apparent to the more intelligent and progressive and, on December 15, 1863, twenty-four engineers or managers of gas works met in Manchester, and formed the British Association of Gas Managers. The need of this movement, and its success, are attested by the results, as to-day the number of members of all classes in that Association is upwards of seven hundred, and its influence is most widely extended. Not only so but, largely from the influence and effectiveness of the parent Association, kindred associations, with like objects in view, are vigorously growing in the United Kingdom, America, France and Germany.

It would seem that no question could exist that highly beneficial results have arisen from the association and intercommunication of intelligent men specially interested in the common welfare of a most important industry. Still there are a few who think otherwise, and consider the old times of high prices, big dividends and closed doors to have been preferable. Happily, the many do not sympathize with this class, and think it will be a fortunate day when such influences are wiped out. It is undoubtedly true that not all of the improvements made in late years are directly traceable to the influence of the meetings and members of the various associations; but many of them are, and, moreover, many ideas, considered practicable by their imaginers, have been proved otherwise when subjected to the combined intelligence of men who had experimented on similar lines, and their demonstrations have, in many cases, been productive of savings to those intending like experiments.

While the Associations have accomplished, up to the present, excellent results, it would seem that there is still room for great improvements in the methods of conducting the meetings, adding to their interest, compelling the attendance of those hitherto negligent, and in the permanent organization and work of the bodies or committees between meetings. The larger associations meet annually, and are dependent almost entirely upon the good will and interest of a few active members in the preparation of papers to be

read and briefly discussed at the meetings. More might be accomplished, and the results would be more valuable, if it were possible, as it seems to be, to perfect the organization by adopting systems whereby technical questions, relating to the manufacture, of great importance, and about which there is difference of opinion, could be referred to committees who could experiment, and determine absolutely the facts, and report at the annual meetings. This would require a moderate expenditure which, in a perfected organization, might be reimbursed from a fund which might well be obtained by contributions or assessments from those most largely interested in the determination of these experiments, the gas companies; as a small assessment, upon the companies represented in the association by their officers, would bring in a sufficient sum.

Moreover the experience of some Associations proves that prizes, offered for the best papers upon technical questions, have brought out most able and interesting contributions to the gas literature of the day.

It is hoped that something may be done by our American Gas Light Association, at its next meeting, that will add to its future efficiency, and that its rapidly growing influence for good may be largely increased. To reach this end it is the duty of each and every one interested in the gas industry in this country to do what he can for the advancement of the objects of the Association.

THE GAS AND WATER COMPANIES DIRECTORY.

We have received three volumes, edited by Mr. Charles W. Hastings, entitled "The Gas and Water Companies Directory, Gas Works Statistics, and Water Works Statistics, for the Year 1881."

The Directory contains the names of the towns, and their population, throughout the United Kingdom in which gas companies exist, and gives the date of their formation, amount of capital, and name of the secretary, manager and chairman.

The Gas Works Statistics gives the statistics relating to each company, including tons of coal carbonized, make of gas, illuminating power, price per thousand feet, price paid per public lamp, and amount of dividends.

The Water Works Statistics gives returns relating to the water works of the United Kingdom.

These books are clearly printed on excellent paper, and are all that could be desired in this respect, and, especially those relating to gas works, are useful for reference, as they give items of information often needed but not always accessible. They can be ordered through us.

The Lighting of the Caisson of the East River Bridge.

The following interesting account of the manner in which the caisson of the East River Bridge was illuminated is taken from the *Engineering News* of June 11th:

LIGHTING.

The subject of satisfactorily illuminating a chamber filled with compressed air has always presented many serious difficulties. A powerful light is required to overcome the want of reflecting surfaces—which are inadmissable because of the mist deposited upon them—to penetrate the thick mist usually present in such places, and to illumine every foot of an uneven soil. The burning of candles is attended with an intolerable amount of smoke, resulting from incomplete combustion. In regard to candle smoke and the method of lighting the Brooklyn caisson, Col. Roebling in his first report remarks:

"This nuisance (candle smoke) was overcome somewhat by reducing the size of the wick and of the candle, and by mixing alum with the tallow and also steeping the wick in vinegar. The inhaling of so much floating carbon is very injurious to the lungs, as the lampblack remains in them for weeks and months; nevertheless, candles had to be used more or less for all special work requiring illuminating close by. Lamps are of little account since they smoke more than candles, and the oil is dangerous in case of fire.

"Fortunately, the existence of an establishment in New York for the production of oxygen gas in large quantities, and at moderate prices, made the introduction of calcium lights quite feasible.

"For a time, cylinders filled with compressed oxygen gas and compressed coal gas were lowered into the caisson and there used. The danger, however, of breaking a freshly-charged cylinder was too great on account of the risk of an explosion. A double system of pipes was therefore put up in the air chamber, one for oxygen and the other for coal gas which takes the place of pure hydrogen. In the end of each chamber was one burner, and a special one next to the water shafts, making fourteen calcium lights in all. In addition, there were sixty burners for common street gas, which was used whenever the supply of oxygen failed. The two gas mains passed to the outside of the caisson, where they connected with two tanks. In order to make the system effective it was necessary to have the gas pressure always one pound or thereabout, in excess of the air pressure in the caisson, and also, to maintain this as the caisson sank. For this purpose the two gas tanks were filled with water from an artificial reservoir, having a head always slightly in excess of the caisson pressure. Into these tanks the gases were discharged from smaller cylinders, under a pressure of 225 pounds. The immediate effect was to force the water from them back into the reservoir, until the tank was full, when the supply was stopped. The pipes leading to the caisson remained open, and the gas passed through them under the pressure due to the artificial head of water. By means of glass gauges the contents of the tanks would be watched and replenished as often as necessary. As the caisson sank, the reservoir was raised from time to time. This was rather troublesome, and was avoided in the New York caisson by placing the gas tank below in the air chamber, otherwise a tower of 80 feet in height would have to be built by degrees. The gases could, of course, have been pumped directly into the tanks, were it not that the stroke of the pump creates an unpleasant jumping of the flame. The oxygen gas was delivered in a compressed state, and the coal gas was compressed on the spot. When the oxygen gas was of good quality, two calcium lights were sufficient for one chamber 102 feet long by 30 feet wide. The heat produced is less than that of a gas flame, and the product of combustion water. One attendant was sufficient for 14 lights, besides all the gas lights. The lime-ball requires occasional turning, as it wears away by the action of the flame, and also requires frequent renewal when water condenses in the pipes. The blow-pipe burners are apt to burn out and get out of order. The explosive flame will also run back and melt the rubber connection. In short, quite an apprenticeship is necessary to adapt the calcium lights to all the new conditions. The only danger lies in leakage of pipes, and from carelessness in leaving the cocks open. One gas explosion took place below, sufficient to singe off whiskers and create some alarm. The sense of smell is so blunted that the leakage of coal gas is not easily detected. But the ordinary gas lights were found to be the most economical. Their cost is only one-fifth of the calcium light, and about one-third of candles. * * * They produce, however, an intolerable amount of heat, and vitiate the air more than candles, although producing but little visible carbon."

In the New York caisson the gas burners first used were five feet fishtail, which burned with a flickering yellow light, consuming much gas and smoking nearly as bad as candles. Experiments were commenced, and it was found that a two feet lava tip, of the pattern known as the "excavated batwing," burned with a clear white light, giving off scarcely any smoke. As the depth increased these also smoked, and one foot burners were substituted, when no further difficulty was experienced. Under a pressure of 35 pounds these burners gave as much light as a four feet one outside.

Artificial Seasoning of Timber.

Mr. C. René, pianoforte manufacturer, of Stettin, Germany, as reported in *Engineering*, has devised a plan by which he utilizes the property of oxygen, particularly of that ozonized by the electric current, to artificially season the timber used for the sounding boards of musical instruments. The first impulse to experiments being carried out in this direction was given by the well-known fact that wood, which has been seasoned for years, is much more suitable for the manufacture of musical instruments than if used soon after it is thoroughly dried only. Mr. René claims that instruments made of wood which has been treated by his oxygen process possess a remarkably fine tone, which not only does not decrease with age, but, as far as experience teaches, improves with age as does the tone of some famous old violins by Italian masters. We are further told that the sounding boards made of wood prepared in this manner have the quality of retaining the sound longer and more powerfully. A number of pianos manufactured at Mr. René's works, and exported to the tropics several years ago, have stood exceedingly well, and seem in no way affected by the climatic dangers they are exposed to.

While other methods of impregnating woods with chemicals generally have a deteriorating influence on wood fibers, timber prepared by this method, which is really artifical ageing, becomes harder and stronger.

The process is said to be regularly carried on at Mr. René's works, and the apparatus consists of a hermetically closed boiler or tank, in which the wood to be treated by the process is placed on iron gratings; in a retort placed by the side of the boiler and connected to it by a pipe with stop-valve, oxygen is developed and admitted into the boiler through the valve. Provision is made in the boiler to ozonise the oxygen by means of an electric current, and the boiler is then gently fired and kept hot for forty-eight or fifty hours, after which time the process of preservation of wood is complete.

COAL CONTRACTS.—Among the successful bidders for the contracts for furnishing coal to the Philadelphia Gas Trust were the Penn and Westmoreland Companies, who will furnish 135,000 tons each at their bid price of $4 65. The Chesapeake & Ohio Railway Coal Agency will also furnish 30,000 gross tons at $4.25.

[Official Report.—Continued from page 272.]

Proceedings of the Fourth Annual Meeting of the Western Gas Association.

Held at St. Louis, Mo., May 11, 12, and 13, 1881.

Morning Session—May 12.

The Convention reassembled at nine o'clock, the President in the chair.

The President—Mr. Munzinger will now favor us with some remarks on the subjects which he stated yesterday he would bring before the Convention to-day.

LOSS OF GAS, ETC.

Mr. Munzinger then addressed the Convention as follows:

Mr. President and Gentlemen of the Convention:—I wish to show you where there are losses in the manufacturing and distributing of gas. We have losses by temperature, by pressure, by moisture, by condensation in the retort; we have losses at the consumer's meter, by bad joints, defective service pipes, etc. In order to explain this intelligibly to you I have prepared some charts, which will show you the temperature and expansion of gases under temperature and pressure.

The experiments of Regnault, Gay-Lusac, and Dalton prove that all gases not in contact with liquids or generating fluids expand very nearly alike by an equal addition of heat, and contract alike by an equal subtraction of heat, under constant pressure. A volume of gas at the temperature of melting ice, which is 32° F., will expand 1.367 volumes when the temperature is raised to that of boiling water, which is 212° F. If the expansion be uniform throughout the 180° F., each degree will represent an advance of .367 divided by 180, or .002039, which expresses the fraction of its own volume, and is called the co-efficient of expansion. This proportion is easily ascertained by addition or subtraction. Thus, a volume of gas at 32° F. equals 1 cubic foot; at 33° F. it will become 1.002039, as I have shown there (indicating on the chart); at 34° F. it would become 1.004078, and so on. As a volume of gas contracts uniformly when subjected to an equal subtraction of heat, it will be found that if starting with a temperature of 32° F., and gradually losing the heat until reduced theoretically to nothing, then we have to divide 180 by .367, which gives us 490.46° below the freezing point; subtracting from this 32° F., gives you the absolute temperature 458.46° below zero. It would not be possible for you, by temperature, to condense that one to nothing, but we have to have some standard to work by, in order to make an intelligible computation. Suppose we wished to reduce a volume of gas from a higher to a lower temperature. This is the formula:

$$V = \frac{v}{1 \times .002039 \times (t - t)}$$

V denotes the unknown volume, v the known volume of gas, t and t the temperature. For example, take 1,000 cubic feet at 70° F., and find what it will measure when the temperature is reduced to 50° F. This will be the formula:

$$V = \frac{1{,}000}{1 \times .002039 \times (70 - 50)} = \frac{1{,}000}{1.04078} = 960.8179 \text{ cubic feet.}$$

This shows that when you distribute gas from your works the loss is pretty nearly 30 per cent. The mean temperatures that we have in this country are about as follows: In January we have 36° F.; in February 38°; in March 41°; in April 46°; in May 52°; in June 58°; in July 61°; in August 61°; in September 56°; in October 50°; in November 43°; and in December 39. This is the average temperature of your station meter. When your gas is measured at the station meter at 70 and passes into the consumer's meter, the volume of gas is contracted by the temperature, and the consumer makes about 3 per cent. by the operation.

Pressure also affects gas. All gases are defined as elastic fluids, because they are elastic and compressible. Their power to resist compression depends upon their weight. An increase of pressure increases their tension but diminishes their expansive force if allowed to expand. The first experiments for this specific purpose were made in 1600 by Boyle and Hook. At a later date Mariotte pursued the subject, and still more recently Arago and Dulong. It may be deduced from their results in general that the volume of gas is in inverse proportion to the amount of pressure to which it is subjected. This fact embodies the principle of the great Boylean law. In order to examine the compressibility of a volume of gas, and the proportion that its density and tension bear to each other, calculations are based upon the Boylean law. Thus if a volume of gas of 1 cubic inch be stored up in a gasholder of an inch square in plane, which is suspended by frictionless hangings, the downward pressure of the atmosphere being equal to 15 lbs. per square inch, and the temperature of the gas kept uniform, we multiply the given volume of gas by the given pressure, and divide the product by the new pressure, and the result is the new volume of gas. The formula used is $V = \frac{v \times x}{x}$, in which V denotes the known volume, v the unknown, and x and x denote the pressures. Here on the chart we have 1 cubic foot of gas, 15 lbs. of atmospheric pressure, divided by 30, which gives us 1 cubic foot of gas.

Then you see here how a volume gets reduced by a pressure of 30 pounds, 45 pounds, 60 pounds, 75 pounds, 90 pounds, 105 pounds, 120 pounds, 135 pounds, and 150 pounds per square inch. By a pressure of 30 pounds we get one-half; by a pressure of 45 pounds, one-third; by a pressure of 60 pounds, one-fourth; by a pressure of 75 pounds, one fifth; by a pressure of 90 pounds, one-sixth; by a pressure of 105 pounds, one-seventh; by a pressure of 120 pounds, one-eighth; by a pressure of 135 pounds, one-ninth; and by a pressure of 150 pounds, one-tenth.

Reversing the foregoing illustrations, suppose the pressure is 30 pounds per square inch and the volume of gas is .5, or half of a cubic inch, what space will this same volume occupy at 15 pounds per square inch? To determine that we divide 30 by 15 and divide the quotient by 2, and we get 1 cubic inch. It is extremely difficult to preserve the pressure and the temperature of a given volume of gas, as the temperature and pressure of the surrounding atmosphere so constantly vary.

Gas is increased in volume by the accession of heat and decreased by the withdrawal of it; consequently its expansive force and density thus experience a change. The expansive force of gas rates at 36.7 per cent. for 180°F. if the pressure remain the same; but if the pressure is varied, though the temperature remain unchanged, there is a variation in the volume. Where an accurate measurement of gas is required, the temperature and barometric pressure must be strictly noticed, for it is customary to refer to the barometric pressure of a column of mercury 30 inches in height, and to the temperature of 60° F.

The following equation is designed for the calculation of a volume of gas:

$$V' = \frac{5 \times x \times (458.46328 \times t')}{x' \times (458.46328 \times t).}$$

x denotes the pressure for the known volume; x′ denotes the new pressure; t′ denotes the temperature for the known volume of gas; t denotes the new temperature. For instance, if the volume of gas be .5 cubic foot at the barometric pressure of 30.5 inches, and at 56° F., what will be its volume at the barometric pressure of 30 inches and at 60°F.? This shows it (referring to the chart):

V = 5 cubic feet. x = 30.5″. f = 56 degrees. x′ 30″ t′ = 60°.

$$V' = \frac{5 \times 30.5 \times (458.46328 \times 60)}{30 \times (458.46328 \times 56)}$$

$$V' = \frac{152.5 \times 518.46328}{30 \times 514.46328} = \frac{7905.6290}{15433.8984} = 5.122855 \text{ cubic feet.}$$

Philosophical experiments and common experience have established as a fact that heat converts water into vapor, which then diffuses itself through the atmosphere. This heat is one promoter of evaporation. If a volume of gas stored up in a gasometer comes in contact with water, it will convert some of the water into aqueous vapor, and in different proportions at different temperatures. Heat expands the gaseous portion, enlarging its particles and augmenting their capacities for containing moisture. When gases are saturated with aqueous vapor they become highly elastic, and this elasticity increases with an increase of temperature until it attains a force capable of supporting a column of mercury at 32° F. equal to .2 of an inch; at 180° F., 15 inches; at 210° F., 30 inches.

For illustration, take a volume of saturated gas at a temperature of 80° F. in an inclosed vessel, and its elasticity will equal 1 inch; but if more vapor be forced into the vessel at the same temperature, instead of increasing the elasticity of the volume already stored, it will collapse and fall in moisture, and should the temperature rise to 90° F. the elasticity of the saturated gas will increase until it equals 1.37 inches. Hence the density and tension of aqueous vapor in a volume of gas standing directly over water depends upon both the temperature of the gas and the water. The pressure of the gas or aqueous vapor is exerted in the same degree in the absence of either, and the combined influence of the gas and vapor is equal to the pressure due to each gas separately. The pressure of the gas stored up in the holder does not prevent the formation of vapor, but merely retards its progress, momentarily obstructing its diffusion; in time, however, it becomes uniformly diffused throughout the entire space of the gasometer.

Although the proportion of aqueous vapor diffused in coal gas is small, its presence to a certain extent diminishes the amount of light produced, and tends to condense the particles of carbon floating in the gas, its amount is in direct proportion to its temperature, its maximum percentage, according to Ure and Dalton, being .6 at 32° F.; .8 at 40° F.; 1.2 at 50° F.; and

1.8 at 60° F. As the percentage of aqueous vapor at 50° F. is 1.2, the proportion in 1,000 cubic feet would be 12 cubic feet of aqueous vapor, with a specific gravity of .6201, in weight nearly equal to 16 cubic inches of water. The amount of the gas absorbed by liquids depends upon the pressure, the temperature, and the chemical nature of both the liquids and the gas. Thus, for instance, a hundred volumes of water will absorb 7,800 volumes of ammonia, but only 15 volumes of coal gas. The volume of gas absorbed by liquids decreases with an increase of temperature and increases with a decrease of temperature; its amount varies directly with a change of pressure; that is to say, the volume of gas absorbed is inversely proportional to the degree of pressure to which it is subjected. Accurate measurement can only be determined by direct experiment.

When we take the losses in gas works we begin first with the retort. Each pound of coke in the retort represents about 30 cubic feet of gas. This is a part of your loss. Whatever carbon you get is a loss, and it amounts, I think, to about 1½ per cent. You will have a loss of one-fourth of one per cent. by condensation, depending on the character of the coal. The loss by the consumer's meter registering slow will be 3½ per cent.; the loss by temperature will be 3 per cent.; the loss by service pipes, bad joints, etc., will be 4½ per cent.; the loss by condensing aqueous vapor will be 1 per cent.; and the loss by pressure will be ¼ per cent. That makes about 12¼ per cent. When the volume of gas is stored up in the gasholder you have to have water, and when the temperature of the atmosphere is about 50° F. you absorb 12 cubic feet of aqueous vapor. As you deliver the gas through your tubes, there is that ¼ per cent. lost by friction for every mile of pipe that you have. The loss by service pipes comes from their being corroded. From my knowledge of pipes in Philadelphia and elsewhere I should say that the life of a service pipe is from 10 to 12 years. A good idea is to test your pipes with a force pump, to ascertain whether they are defective. The loss from this cause is a very serious one. When pipes are laid through mud, coal ashes, or sand, they become pock-marked. When pipes go through salt water they are converted into plumbago; a gentleman in New Jersey told me that he had seen the pipe in such a condition that it could be cut like cheese.

We have all heard about the "lying meter," but when it registers it generally registers from 3½ to 4 per cent. in favor of the consumer; that is about your loss from your meters, according to my experience and that of Mr. Ford, of Washington; that is, out of a loss of 15 per cent., 3½ per cent. would be chargeable against the meter. I think these meters should be proved every six months, and then there would be no complaints.

There are frequently complaints of bad gas, and I desire to give you a little of the theory that has been brought forward by Mr. Faraday, Mr. Tyndall, and others. The greater your barometric pressure is, the greater will be the illuminating power of your gas; and the less pressure, the less will be the illuminating power of your gas. When we fire up a boiler, as we all know, about nine-tenths of the heat goes up the chimney, and the other one-tenth does the work. In regard to the gas stoves that I spoke of, there is this further to be said about them: When you start a fire in an ordinary stove it takes a good while before you get your combustion in right shape. You lose very nearly 15 per cent. in getting the proper heat, and you lose 30 per cent. after your fire is ready for cooking. All that goes to waste. In a gas stove you turn your heat on, and in a few minutes the work required of it is done. It is also much cleaner than the ordinary stove, and in summer time it is far preferable to any coal stove. You all know that, in firing retorts by coke, if you make 20 feet of gas out of one pound of coke you are doing well. But if you have a gas furnace, such as the Siemens furnace, you can get 25 feet to the pound. All you want is to get your fire as deep as you can.

On motion of Mr. Howard the thanks of the Association were tendered to Mr. Munzinger for his address.

The President stated that Mr. Gimper would address the Convention on the subject of the economical use of heat.

ECONOMICAL USE OF HEAT.

Mr. Gimper then read the following paper, which he said was a translation of a German work on the subject:

Report of the Commission upon Generators to the German Gas Light Association. By Messrs. E. Grohn, S. Schiele, and Dr. Schilling. Made at Bremen, June 18, 1879.

The material for the production of heating gases in gas works is coke, which varies very much according to the different qualities of coals from which it is produced, 1, in regard to contents of ashes and clinkers; 2, in regard to the nature and fusibility of the clinkers; and 3, in regard to its density hardness, and cohesion. Hence, accordingly as the coke lies close or loose in the generator, it produces more or less clinkers; and according as such clinkers are fusible at a high or low temperature, and to what degree they will bake and conglomerate together, in that proportion will it be necessary to maintain a certain draught to produce a certain volume of heating gas and a normal condition of the generator.

A generator was constructed without a grate, in place of which two slits opposite each other were used. Diameter of generator, 3 feet; height from slit opening to under side of flue, 4 ft. 6 in.; flue, at neck of generator, 9 in. in diameter, or one-fourth the size of generator shaft. The filling of generator was done from the top, and opening closed by a luted lid. To avoid any possible chance for explosion of the gases of combustion before reaching into the chimney, which was 108 ft. high, a combustion chamber was constructed of sufficient dimensions to burn all the gases, and for the control of draught, a damper was placed in flue; length of flue from generator to combustion chamber, 15 ft. For measurement of draught an ordinary water gauge was used; also the very sensitive gauge of Scheurer & Kestner; also a Crosly self-registering for under pressure was used.

Trials with Coke from Saar Coal.

Trial A.—The damper was opened to 1 1-16 inches, giving at the beginning a pressure of —0.25 m.m., which gradually rose in the flue to positive pressure of +1 mm. The appearance of this rise in pressure is explained by the upward tendency of the specific lighter and hot gases of the generator being greater than the resistance, which have opposed the slower moving gas stream. Hence a flue or chimney giving 1.5 mm. pressure would draw sufficient air for a consumption of 44 bushels of coke for 24 hours.

During the trial pressure varied from +1 mm. to +0.25, or an average of 0.45 mm., with a consumption of coke of 44 bushels and 6½ bushels refuse.

Six different tests of gas in flue showed its combination, as an average, CO_2, 1.5 per cent.; CO, 29.2 per cent. Gas test taken at different heights of generators showed the following combinations:

	At VI.	At VIII.	At X.
CO_2.....	1.8 per cent.	2.0 per cent.	3.4 per cent.
CO.....	29.8 "	29.6 "	25.8 "

Trial B.—The same damper opening was kept up for 48 hours longer, during which time the draught varied from 0.5 mm. to +1 mm., with an average of 0.74-mm. Consumption of coke per 24 hours, 43¼ bushels, with 6 bushels refuse. On the other side of damper tile the draught showed —6.4 mm. to —10.2 mm. After every 45 to 50 minutes clinkering took place without difficulties.

The pressure in flue at III. was +0.8 mm.; at the neck of generator, at V., 0.3mm.; being 4½ feet from bottom of generator, at VI., 0 to +0.2 mm.; at VII. and VIII., 0 to —0.05 mm.; at X., —0+5 to —0.25 mm.

The pressure observed in the flue is therefore due to the highly heated and specific light gas column above the coke.

Measurements taken with bent tubes, with and against the draught, showed no material difference in themselves.

Analyses of gas in flue for an average of six tests gave 2.0 per cent. CO_2, and 28.3 CO.; at bottom test hole—

CO_2.....	1.4	1.5	4.6	4.6
CO.....	...	26.8	23.4	26.4

The large per cent. of CO_2 in flue is owing to the test holes being opened often and not hermetically closed, Analysis will always show a proportionate amount of CO_2 when there is the least opening either in generator or flue, whether from test holes or joints in brickwork. It is therefore recommended for practice to reduce the length of flue to a minimum.

Of the different gas tests taken at X. of generator (between 19 and 20 in. above bottom) showed that here the greatest part of CO_2 had already been reduced to CO; the coke immediately above reduced the CO_2 contents only from 4 per cent. to 2 per cent.

For the purpose of analysing the gases with fuel at different heights the coke was allowed to burn down to within 20 inches from the bottom, from 3 P.M. to 11 P.M., during which time the analyses of these gases showed no practical variations.

Hence filling the generator three times in 24 hours would produce a heating gas of like combination throughout. The measurements of temperature with Siemens water pyrometer showed in flue at II. 932°; at V., 1042°—under the circumstances the loss of heat being 110° in a distance of 6 feet. At the upper test hole at VI. two tests showed 1337° and 1382°.

Trial C.—

After opening damper from 1 1-16 to 1 3-16 inches, three gas tests in quick succession were taken: 1, under normal conditions; 2, after loosening luting of generator cover; and 3, after generator was opened. The results were as follows:

	First Test.	Second Test.	Third Test.
CO_2.....	1.2 p. ct.	4.2 p. ct.	3.2 p. ct.
CO.....	28.8 "	26.2 "	....
O.....	....	....	17.8 "

At 12 o'clock M. the damper was opened to 11 inches, and the draught showed in flue —3 mm., which kept on increasing, holding an average of —3.7 mm. After a few hours the generator became very hot, and the slit openings suffered considerably from the high heat. At 6:45 the draught

had increased to 6.6 mm., which, after careful clinkering, went back to 5.6 mm. The peculiarity of increase of draught with the accumulation of clinkers occurred in two other instances, but only with strong draught. The gases taken during this time always showed themselves cloudy from very fine flue ashes, which would not settle down after passing through a pipe 9 feet long and having several bends; and when shaken with water would remain suspended until after CO_2 was absorbed by alkali, when the water would become clear. Analysis showed the ashes to be mostly silica acid. The average composition of gases was—CO_2, 33; CO, 26.9. There was very little variation, even up to the time of the fuel being burnt down to within 20 inches.

Generator was refilled with 14 bushels of coke. It soon became very hot, so that it was painful to the eye to look into it. Two cast iron sight boxes had melted together; the combustion chamber showed a full white heat, and the entire length of flue appeared red. The highest temperature observed during the trial at II., with water pyrometer in copper cylinder, showed 2067°. The damper was closed at 8 P.M., having consumed 32 bushels of coke, or at the rate of 99 bushels per 24 hours.

Trial II.—At 9:50 A.M. the damper was opened to 10½ inches, and during 12 hours (from 11 A.M. to 11 P.M.), in very windy weather, the pressure varied from —1.5 mm. to 3.9 mm., with an average of 2.8 mm. Consumption of coke for 12 hours, 45½ bushels; 91 for 24 hours.

Analysis of gases:

CO_2.....	2.6	2.9	3.2	3.4	Average, 3.0
CO.....	25.2	27.4	28.2	26.2	Average, 26.9

Temperature with water pyrometer in flue at II. showed 1292° to 1382°; in flue at V., 1472° to 1562°. Two hours later a temperature test with the electric pyrometer showed 1090° at II.

During the trials, even by slow draught, it was noticed after the cooling of the generator that it had suffered considerably, especially near the slit openings, from the contractions of the bottom. Large blocks having been used on one slit, and the usual size on the other, supported by an iron rail, which soon had melted away, and had to be supported by brick. Even the walls of the generator itself had been considerably attacked by the easily fused clinkers.

To protect the lower part of the generator from this rapid destruction, water was placed in pans under the slit openings and allowed to evaporate, with very good results.

With an average draught in flue of —6.7 mm. for 12 hours, the consumption of coke was 69½ bushels, or 139 bushels for 24 hours; 264 pounds of water was evaporated in 12 hours, or a fraction less than 2 gallons per bushel of coke. The clinkers did not collect as fast nor seem to be so destructive by high draught as by slow draught without water.

Trials with Coke from Bohemian Black Coal.

The coke from this coal was very different from the preceding one, and the management of the fire had to be entirely different. Where the clinkers of the former fused easily and ran down through the slits, these would, on reaching the cooler parts of the slits, become hard and attach themselves very firmly to the brickwork, soon forming a solid mass of clinkers, which prevented the feeding down of the fuel to the slit openings, so that some changes in the generator became necessary. After this the rapid accumulation of clinkers could only be partially prevented.

After eight trials the generator showed in its lower part a diameter of 14×18 inches, its original diameter having been 3×3 feet. It soon became apparent that a continuation of such conditions would have to be changed; hence the generator was charged with Saar coke, and soon the accumulation of stone-hard clinkers was removed by the easy-fusible clinkers of this coke; and for the remaining trials a mixture of 9 parts Bohemian and 1 part Saar coke was used, with much better results, but only entirely satisfactory when grate bars and water in the ash pan were used.

Trial A.—After 12 hours firing in generator with normal draught in chimney, the damper was opened far enough to give a draught of —5 mm. Soon, however, as usual, positive pressure showed itself before the damper till it rose to+1 mm. During the 23 hours' trial the average pressure in flue was +0.86 mm. The fuel was renewed every 3 hours, filling the generator to the neck. Consumption of coke for 23 hours, 48 bushels, with 18.85 per cent. refuse, or 41 bushels for 24 hours, after deducting refuse. An average of 8 tests taken from flue at III. had the following combination of gases: CO_2, 14 per cent.; CO, 29.4 per cent. At different heights of generator the gases were of the following combinations, after 3½ hours' burning down: At VIII., CO_2 1 per cent., CO, 31.6 per cent.; at X., CO_2 4.8 per cent., CO 25.2 per cent. Temperature of flue inside of 10 minutes, at VIII., 1112° to 1157°; at II., 824° to 887°.

Gas issuing at V. did not ignite; that from II. did, burning with a blue flame.

Trial B.—After filling the generator to the neck again the damper was opened until a draught of —5 mm. appeared in the flue. During the trial it varied, with an average of 4.5 mm. The consumption of coke for 12 hours was 48½ bushels, with 15.82 per cent. refuse. A gas test during the fifth hour showed CO_2 3.6 per cent.; CO 23.2 per cent. After filling of generator again for the last time, and testing gas during the third hour, it was found as follows: CO_2, 7.5, 7.5; CO, 22.5, 22.5. During the fourth hour: CO_2, 10 per cent.; CO, 17.2 per cent. The flue became in the meantime very hot, being at II. 1778° and at V. 2154°.

To prove the drawing in of atmospheric air through the brickwork, two tests of gas were taken simultaneously, one at highest sight hole of generator, at VI., and the other in flue at III., with the following results:

At generator.... CO_2, 8.2 per cent.; CO, 18.4 per cent.
In flue .... CO_2, 10.0 per cent.; CO, 17.2 per cent.

Half an hour later gas showed 5.4 per cent. of CO_2; 15 minutes after, 2.7 per cent. CO_2 and 22 per cent. CO. An hour after coke was all burned down and gas contained oxygen in its combination.

Trial C.—An average draught during 26 hours of 5.24 mm. was maintained. An ash pan with water was used for the purpose of ascertaining if, by rapid cooling of the clinkers, they might become more brittle and porous. Forty gallons of water was evaporated for the purpose, but without reaching the desired result. Consumption of coke, 161 bushels, with 16.90 per cent. refuse. Gas in flue (the average of 8 tests), CO_2, 6.3; per cent.; CO, 21.1 per cent. Temperature in flue at II., 1482°; at V., 1742°

The next morning at 8 o'clock the generator was filled again and then allowed to burn down. Temperature in flue at II. rose to 1787°. In the second hour during the burning down gas showed: CO_2, 7 to 8 per cent.; CO, 18.8 per cent. In the third hour: CO_2, 8.4 per cent.; CO, 15.6.

After coke had burned down below sight hole IX., gas was tested again direct from above the coke. In the fourth hour it showed CO_2 4, 6, 8, 7, 8 per cent.; at the end of the fourth hour, at sight hole X., height of fuel 18 inches from slit, it was found with 8 per cent. CO_2; in 15 minutes after 13 per cent. CO_2 was found.

Trial D.—The average draught for this trial was —5.5 mm. Consumption of coke for 24 hours, 80 bushels. Combination of gases in flue at III. at different times was as follows:

CO_2....	1.2	2.0	2.4	Average, 1.8 per cent.
CO.....	29.3	28.0	27.2	Average, 28.2 per cent.

Two and a half hours after filling, test taken at VIII. showed 2 per cent. CO_2 and 29.6 CO. At II. in flue temperature was 1382°. The generator had not been filled to the neck for some time, but only to VIII., or 3 feet over the slit. No change in the composition of gases was noticeable during a 4 hours' trial.

Trial E.—The generator was filled to the neck, with a draught of from —9 mm. to —13 mm., or an average of 11.8 mm., which was kept up for 24 hours. Consumption of coke, 203 bushels, with 13 per cent. refuse. By this large coke consumption the filling at every 3 hours caused great irregularities. The gas in flue contained during the burning down as high as 15 per cent. of CO_2. Immediately after filling, tests at III. showed 6 per cent. CO_2 and 22.4 CO; hence an average of 12 per cent. CO_2.

It was clear that by very high draught air was drawn in through every joint, and even through the porous brick itself. During a period of 6 hours gas showed the following composition, taken at VI.:

CO_2....	2.8	3.0	3.0	Average, 2.9 per cent.
CO.	25.4	26.0	25.2	Average, 25.5 per cent.

The generator was again filled, for the purpose of testing gases during the burning down, taken only from the lowest test hole, X., with height of fuel at 18 inches:

CO_2.....	5.6	5.4	5.0	4.4 per cent.
CO.....	26.2	26.6	27.0	.... per cent.

The generator was then opened, showing little accumulation of clinkers. It was filled again to the neck, when soon a very rapid change in barometer took place, causing great variations in draught, 28 bushels of coke having been used, which burned down in 5½ hours. During the 5th hour, gas taken at IX. showed the following combination: CO_2, 7 and 5 per cent.; CO, 23.4 and 23 per cent. After 5 hours, gas in flue was composed of CO_2, 18 per cent.; CO, 3.6 per cent.; and a few minutes after fuel was burned down.

Temperature at II., 1922°; at V., 2100°. Copper cylinder melted during the last test.

Trial F.—This trial was conducted for 19½ hours, with slower draught than the previous one—namely, an average of .6 mm. Unscreened coke was used, while before only screened coke was used. The proportion of coarse coke to small and dust was 60.5 to 39.5 Of course, the consumption of coke was less than with screened coke, it being for 19½ hours 74½ bushels, with 18.45 per cent. refuse.

Combination of gases at III. in flue was in the second and fourth hours after filling generator as follows:

CO_2....	7.2	7.2	6.4	8.0	Average, 7.2 per cent.
CO	21.2	20.8	20.4	18.6	Average, 20.3 per cent.

During the same time tests were taken from the generator at VI., from the center of gas column, containing much less CO_2:

CO_2....	1.0	0.6	2.6	1.0	Average, 1.6 per cent.
CO.....	27.8	28.6	30.8	31.0	Average, 29.6 per cent.

There is therefore no doubt that quite a large quantity of air is drawn in through the sides of the generator and the flue, with which a part of the CO is burned. Notwithstanding the greatest care having been used in making all the joints as perfect as possible, the porous condition of the brick also would admit air. With the proportionate increase of draught, CO_2 increases in the same ratio.

Trial G.—Unscreened coke was used in this trial, and draught increased to 7.4 mm. Notwithstanding, the consumption of coke was not much larger; for 21½ hours it was 88 bushels, with 22 per cent. of refuse. Combination of gases during 5 hours averaging CO_2 8.3 per cent., and CO 16.7 per cent.

The generator had been filled every 3 hours. During the third hour after the last filling gas in flue was composed of 8.8 per cent. of CO_2 and 18.4 per cent. of CO. In the following two hours, tests taken just above the fuel gave the following analysis:

	10:30 A.M.	11 A.M.	11:30 A.M.	11:35 A.M.
CO_2....	4.4	6.0	5.6	5.4
CO	26.0	23.0	19.4	19.8

A short time after the last test was taken fuel was burned down. At 12 M. 7.4 per cent. CO_2 and oxygen were found; 10 minutes later no oxygen was found.

After opening generator, it was found that clinkers had accumulated considerably. The remaining opening in the middle was 10×19 inches. On the sides the clinkers rose to a height of 18 inches.

Trial H.—During this trial the slit opening opposite the flue was closed, for the purpose of observing the action of the generator under unfavorable draught. It was soon noticed that the fuel just over the slit opening was much brighter than on the opposite side. Gas tests from flue showed the following combination:

CO_2....	8.4	8.4	5.4	Average, 7.4 per cent.
CO.	19.6	18.8	23.8	Average, 20.7 per cent.

Gas tests taken above fuel:

CO_2....	5.5	5.4 per cent.
CO.	24.0	24.0 per cent.

Later tests taken at III. showed larger percentage of CO_2—12, 10, and 9 per cent.

Temperature in flue at V., 1742°; at III., 1562°.

The generator was now changed for the purpose of using grate bars and water in ash pan; and as soon as a normal condition was reached the generator was only half filled, for the purpose of observing its condition with a small quantity of fuel and low draught—from 2 to 3 mm. Consumption of coke, 128 bushels per 24 hours, with 17 per cent refuse. After 24 hours the generator was opened, and on examination it was found that around the grate bars a considerable amount of clinkers had accumulated, which, upon cooling, were easily detached. The water had evaporated but slowly during the trial, 30 gallons of water having been consumed in the 24 hours. During the subsequent trials the ash pans were brought much closer to the grate bars and fire put under them, so that 140 gallons were evaporated during the 24 hours following.

Gas tests with small quantity of water and 2 mm. draught, taken from generator at IX., with 2½ feet of fuel: CO_2, 5 per cent.; CO, 25.6 per cent. With 4 mm. draught, two hours after filling: CO_2, 8 and 7.4 per cent.; CO, 18.8 and 16.2 per cent. After burning down of fuel, temperature in flue at II. was 2192°.

Generator was then cleaned by burning Saar coke, after which 3 trials, N., O., and P., were made in succession, with but little variation in results, as shown below:

Analysis Showing Percentage of H_2.

	N.				O.			P.	
CO_2,	5.4	5.4	4.4	4.4	6.0	5.8	4.0	5.2	5.2
CO .	23.2	22.6	23.0	22.0	17.4	24.4	26.2	23.2	23.4
H_2..		5.2	5.4	5.4	4.7	5.5	5.5	8.8	8.4

Other tests were made, showing that too much water had been evaporated:

	N.		O.
CO_2.....	10.4	7.8	9.0
CO.....	16.4	21.4	18.8
H_2.....	8.6	6.7	7.5

The last filling of generator took place at 10:15 A.M. The average combination of gases from 10:30 A.M. to 2:45 P.M. was—CO_2, 4.0; CO, 26.2; H_2, 5.5; and at the beginning of the fifth hour, CO_2, 5.8; CO, 24.4; H_2, 5.5, with a height of fuel of 0.50 meter.

	Per Ct. CO_2.	Per Ct. CO.	Per Ct. H_2
At 4:00	9.6	17.2	3.1
At 4:15.....	12.8	11.6	No test.
At 4:35.....	15.6	4.4	No test.
At 4:45.....	16.2	....	No test.
At 4:50.....	16.0	....	No test.

Thus proving conclusively, as in previous trials, that the combination of gases remains quite regular when fuel is above 0.50 meters in height.

English Coke from Leverson, Wallsend, and Nettleworth Primrose Coals.

The action of the ashes and clinkers of this coke was very different from any other. The clinkers were easy-fusible, dropping down through the slit openings, and upon cooling forming threads like glass. After 10 days' use of this coke the tiles forming the slit opening showed a wear of 0.15 m., or 3½ inches. Clinkers forming around slit openings were easily removed. Trials D. and E. were of most importance, one being with high and the other with low draught.

During a four hours' burning down in Trial D., 25 bushels of coke was consumed, with a height of fuel of 1.50 m. (4½ ft.) at beginning, and 0.75 m. (2½ ft.) at ending, with no variation in combination of gases. A gas test directly after filling contained 5 per cent. CO_2 and 21 per cent. CO, the average during the entire test being 4.8 per cent. CO_2 and 22 per cent. CO. After filling followed a period of burning down, in which the gas at the close of the fourth hour in the flue contained CO_2 4.4; CO, 21.4; height of fuel, 0.5 m. As soon as the fuel burned below that point CO_2 rose to 7 per cent. After opening generator, a luminous flame with a white smoke arose from it, caused by the decomposed salts of the ashes. A perfectly white heat, painful to the eye without green glasses, was observed. As with other cokes, the coarse English coke, with a good draught, gave a good heating gas with fuel 0.5 m. high.

The opinion seemed to gain strength that by the high temperature at the slits the coke is not burned to CO_2, but direct to CO, since CO_2 by high temperature separates into CO and O, under these circumstances CO being the more permanent gas.

The damper was closed, soon after the fifth hour of burning down, to a draught of 2 mm., and shortly after filling of generator gas tests showed CO_2 1 per cent. and CO 28 per cent. During a 20 hours' trial (E.) only a small consumption of coke took place—11½ bushels.

The temperature, which during the previous trial had risen to 1900°, 12 hours after had fallen to 932°. But the greatest peculiarity was that at the beginning only 1 per cent. CO_2 was found in the gas; after 6 hours, 6.8 per cent.; 12 hours, 7 per cent. Entrance of air through the generator sides was impossible, there being a positive pressure of 2 mm. inside. Tests taken at X. and III. corresponded in combination. There is therefore no doubt that the heat was not high enough to reduce the gases with 6 per cent. of CO_2 any further.

Generator was now changed from slit to grate bars, and steam used instead of water in ash pans.

Trial J.—Draught was regulated to 1.8 mm. During 21 hours, 47 bushels of coke was consumed. Gas test taken in flue at III. gave CO_2 12.1, CO 13.6, H 12.3; or 25.7 per cent carbon containing gases, and 25.9 per cent. burning gases. It was calculated from the above combination that per 1 kg., or 2.2 pounds, of consumed fuel, 0.72 kg. steam was reduced in generator, with a temperature in flue at II. of 1222°. The refuse upon the grate bars was a loose, brittle, easily removed clinker. During the above trial Siemens' pyrometer gave a temperature of 1796° to 1800° inside of generator.

Trial K.—Steam pressure and valve opening remaining the same, draught was increased from 2.5 mm. to 6 mm., and thereby the coke consumption increased, with the steam supply the same. The change showed itself at once by a less percentage of CO_2 and H_2. An average of 5 tests gave—

CO_2.....	9.5	C. gas, 26.7
CO	17.2	
H.	6.8	Burning, 24.0

In this case a steam supply of 0.38 to one of coke was reduced. After 8 hours burning brittle lumps of clinker were found upon the grates, and between the coke fused clinkers had dropped down, showing that the amount of steam was insufficient, and not until the gases contained 11 per cent. of H_2 were the same conditions, as in previous trial, reached. After 12 hours further burning ashes were principally found upon grate, and at the close of trial a temperature of 1382° was found.

Trial L.—Draft was now reduced to 4 mm., whereas steam remained the same. In a short time the percentage of CO_2 and H_2 rose considerably. Tests taken from flue showed an average of—

CO_2	16.2	Gas containing carbon	24.3
CO	8.1	Burning gas.....	23.0
H_2	14.9		

In this instance 0.91 kg. steam per one of coke was reduced. There is no doubt that by this large amount of H_2 the maximum was reached, and even an excess of it was allowed to pass into generator. In fact, water was condensed in a cold glass tube used during the aspiration of gases. A clean iron pipe was then introduced into the generator, which soon became red hot, and gas taken through it would reduce the steam further, as some two tests showed, giving an average of CO_2, 14.0; CO, 14.9; H_2, 24.3. From this it would appear that 1.27 of steam had passed through the generator per one of coke.

That the complete reduction of steam had taken place through the iron pipe was proven by taking gas tests through a glass tube, protected by an iron pipe, the analysis of which gave CO_2, 16.0; CO, 8.6; H, 15.0. From the first analysis it was found that 0.91 steam was reduced; from the second, 1.27. It would therefore seem that .25 of steam had passed through the generator without being reduced.

Under the circumstances the temperature must have fallen to a minimum, by which a further decomposition of water could not take place. Two temperature tests, taken at VII., height of fuel, 1.5 m. gave 1500° and 1688°; after six hours trial, temperature sank to 1232°.

Trial M.—This trial was conducted with leas draught and steam. As the steam pressure during the trial increased so did the percentage of CO_2 and H_2. Analyses showed the average gas to be--

CO_2.....	12.7	27.5 containing C.
CO	14.8	
H	14.4	29.2 burning gas.

On an average, 0.78 steam was reduced per one of coke. The refuse upon grate bars was almost entirely ashes, with very small clinkers. Consumption of coke per 24 hours, 35 bushels; draught, 2.4 mm.

Trial P.—With draught at 10 mm., steam was regulated to give 14 per cent. H, just enough to prevent the formation of clinkers. A gas test taken at VI., gave CO_2, 10.0; CO, 19.2; H, 14—or 29.2 C. containing gases, and 33.2 burning gases, with a consumption of coke of 122 bushels for 24 hours.

Final Conclusions—Slit Generator.

Consumption of coke, with each kind of coke, is increased in the same proportion as the draught increases.

Unscreened coke requires from 3 to 4 mm. more draught. Screening removes 20 per cent. of small coke and dust.

A draught of two mm., with a consumption of 50 bushels of coke, is sufficient to heat a bench of seven to eight retorts. The question would then arise—could, with higher draught, and a corresponding quantity of coke, two or three benches be heated? To answer this question three factors must be taken into consideration.

1st. The drawing in of air through the upper part of generator and flue, which, in spite of all precautions will take place, and thereby burn a part of the CO into CO_2 before it reaches the bench.

2d. The greater the draught the greater per cent. of CO_2 in the gases. One mm. draught gives 1.9 per cent. of CO_2; 7 to 10 mm., 5.8 per cent.

3d. The higher the per cent. of CO_2 rises, the higher the temperature with which it passes through the generator and flue to the bench. The difference in temperature of gases containing 1.9 per cent. CO and 5.8 per cent. is 932°.

The cooling off of the heating gases is also an important factor. The loss of heat on three feet length of flue was from 122° to 167°. The cooling of the gases is dependent upon the absolute temperature of the gases; in other words, the difference between them and the outer air, also, upon the rapidity of the movement through the flue.

The higher the temperature of the gases than the outer air, or the slower their movement through flue, other conditions being the same, the greater will be the loss of heat. It is therefore more economical to produce heating gases with high draught, even if the greater part of its CO has been reduced to CO_2 before reaching the bench, by reason of its greater rapidity through the flue. Per cent. of heat lost by low draught is found to be 23.2 per cent.; by high, 19.7 per cent.

Hence the question as to the economy of supplying more than one bench with one generator is not so easily solved. For one bench the flue can be reduced to a minimum, whereas two or three would increase its length correspondingly.

All the different kinds of coke produced under similar conditions heating gases of chemically-like combinations. The following table may be considered a guide for the different draughts:

	Draught 1 mm.	High, 7 to 10 mm.
CO_2.....	1.9 per cent.	5.8 per cent.
CO.....	28.3 "	22.6 "
Nitrogen	69.8 "	71.6 "

In regard to the height of fuel and its influence upon the combination of the gases, it has been found, with all the different kinds of coke alike, that when the height of fuel has fallen to 0.5 m. or lower, the percentage of CO_2 with high and low draught would increase considerably. This seems to have been caused by holes having burned through the fuel in some places faster than at others.

In regard to clinkers, it was found that the easier they were fused the more destructive they were to brickwork.

Conclusions in Regard to the Use of Grate Bars and Steam.

With each kind of coke, by the use of the proper quantity of steam, that point can be reached when the refuse from the combustion will not melt and conglomerate together into cakes, but it can be made into a porous and loose mass. If not enough steam is admitted, then clinkers will appear. On the other hand, if too much steam is allowed to pass into the generator, then it will cool it off, the process of decomposing water will be disturbed, and the production of heating gases will gradually stop.

The proper quantity of steam for a normal condition of generator is dependent upon the fusibility of the clinkers of the different kinds of coke, which is shown by the following table:

Steam:	0.79	0.71	0.71	0.70	0.53	0.49

All the difficulties arising with the slit generator and its attendance are reversed with the grate generator and the proper quantity of steam. More draught is needed to burn a given quantity of fuel in a certain time with grate and steam than by slit.

The chemical combination of the gases produced by combustion with steam is CO_2, CO, H_2, and Nitrogen.

Two chemical processes of decomposition take place at the same time:

1st. The combustion of coke with air to CO_2 and CO.

2d. The decomposition of steam into H_2, and the formation of CO_2 or CO from the oxygen of the steam.

Experience has taught that by increased steam the value of CO_2 and H also increased, whereas the CO and N decreased in corresponding degree. To judge if the heating gases produced with steam have a greater or less value than those produced by the dry process, we have taken the chemical combination and temperature into closer consideration. It is a matter well understood that by the decomposition of steam in the generator one cannot lose or gain any absolute heat. The heat units which are absorbed by the decomposition in the generator are reproduced by the burning of H in the burning chamber; or, in other words, a certain amount of heat is made latent for a time. But by the introduction of steam the quantity of the gases produced by the combustion of one part of carbon is changed, as also is the heating value of the same.

The carbon does not need to draw all its oxygen from the air, but takes the O from the decomposed water, and therefore will not have so much of the dead gases or nitrogen. But we do not reach such a complete reduction of CO_2 to CO as by the dry process. The heating gases contain a larger per cent. of CO_2, but this disadvantage is overbalanced by the formation of H_2, as the sum of burning gases is higher than by the dry process. Also, the heat lost by radiation is less by the wet than by the dry combustion, the total loss by radiation by the dry process being 21.5 per cent., and by the wet process 13.8 per cent.

There remains no doubt that the wet process has decided advantages over the dry, not only in the higher value of heating gases, but also in the preservation of brick work.

[The foregoing is, as nearly as possible, a complete reproduction of Mr. Gimper's paper, as read by him before the Association, and as furnished to us by the Secretary in his official minutes of the proceedings.—Ed.]

Discussion.

The President—The generating furnaces referred to by Mr. Gimper, in his translation, are very good in their way; but if I read the translations which I have read of German works correctly, these generating furnaces, to be used under retorts, are no improvement in the making of our gas. They make no more gas per ton. I get this impression from the translations I have read; but, of course, I will not say that that is correct. I understand that they make no more gas per ton, as I say, but they get more yield per mouthpiece. They are no saving whatever, except that they do not make as large a retort house. I do not wish any of you not to adopt them, but my opinion is they will not pay ten per cent. on their cost.

The thanks of the Association were, on motion, tendered to Mr. Gimper for his translation.

NEW MEMBERS.

The Committee on Applications for Membership reported the following names for regular membership:

W. A. Agard, Des Moines, Iowa; J. S. Ambrose, Jefferson City, Mo.; H. D. Wood, of Joplin, Mo.; and the following names for special memberships—G. C. Hicks, Chicago, Ills.; and D. Davis, Iowa City, Iowa.

The report of the committee was adopted, and the gentlemen named were elected as members of the Association.

At this point the Association took a recess.

AFTERNOON SESSION—MAY 12.

The Association re-assembled at two o'clock, the President in the chair.

The President announced that the next subject for discussion was

THE TREATMENT OF GAS AFTER LEAVING THE RETORT.

Mr. Smith (Grand Rapids)—The works with which I am connected have been in operation since 1857, and we have been going along with our old apparatus. They are ten inch works. We wash first, then we condense, then we purify, and then it goes through the exhauster. We have no scrubber. We made last year pretty nearly 34,000,000 feet of gas altogether. In the summer time we use generally two or three benches of fives. Since we have had the exhauster, which is over eight years, we have run it right along. We never could make more than 8,000 feet to the ton before we got our exhauster in; and since we have had it in, with the same kind of coal, in 1879, for instance, we made 29,044,000 feet, the average yield was 9,260, and the net yield was 8,177 feet to the ton of coal; in 1880 we made 33,140,000 feet, and the average yield per ton of coal was 9,200 feet. Last year we got some wet coal and the average was low. In regard to the wet coal I found that there was less yield from it, and that the illuminating power was less. We had to put in more cannel coal to get the proper illumination. I found no trouble from naphthaline with wet coal, but I found that it affected the retorts. I prefer dry coal to wet coal.

The President—Our works are small works, six inch works, in fact, too small to be economical. We use an exhauster, and have done so all the time, and in twelve years it has never stopped twenty-four hours except once. We ran the exhauster when we made only 18,000 feet a day, and the amount of gas sold per ton was greater with the exhauster than when we made gas without it.

The exhauster counterbalanced the leakage and condensation, and we collected for more gas than we did before. It runs a little over 80 feet of six inch pipe, and the condensers are 200 feet of six inch pipe, all set above the heads of the men, and all exposed to the circulation around the retort room. The result of my investigation of the leakage is as follows:

In 1876 we sold, per net ton of 2,000 pounds, 7,941 cubic feet. That is, we collected for that. The gas used around the works is not included in that. That is the net product of the pounds of coal used in 1876. These are all to the first of April of the years named. Our leakage in 1876 was 11.21 per cent. of the gas made. In the spring of 1877, the first two months of the spring, we uncovered every joint that had been in the ground for ten years, and put in new joints, and in 1877 we sold 8,522 cubic feet per net ton, and the net loss was only 4.54. In 1878 we sold 8,902 cubic feet, and the loss by leakage was 4.49. In 1879 we sold 8,850 cubic feet, and our loss was 5.40. In 1880 we sold 8,521 cubic feet, and our loss was 5.01. At 2000 pounds to the ton the average sale per net ton in five years was 8,548 cubic feet, and the average leakage was 6.13 per cent. Taking 2240 pounds to the ton the average sale per net ton for five years was 9,568 cubic feet.

English gas men do not turn out as much gas per net ton of coal as we do, but they sell the coal tar, the ammoniacal liquor, the sulphuric acid and everything of that sort. We have been doing just the reverse of that. Our coal is substantially the same as theirs, except that, in some instances, it is a little drier, and takes somewhat longer to burn. The coal used in Germany is very soft, and the engineers there are now engaged in examining the question whether they shall get 10,300 or 9,800 feet to the gross ton. The question with them is whether it pays them better to take the other 500 feet or to go back 500 feet and get a greater amount of naphthaline, light vapors and all those things which are broken up by distillation, and which we call light coal oils.

As I say, we have really been working the other way. We have all the time been engaged in getting the greatest possible amount of gas, because that is the way we have been making our living; but as the country is growing thousands and thousands of dollars' worth of these outside products will be made use of, and it is going to be a question with us whether we shall get more gas, or whether we shall get less gas and more of other things. The coals I used in my works were some Illinois, some Indiana, and some cannel. I use very little cannel when I can get what is called Pittsburg basin coal. As was stated by Mr. Smith, our worst leakages occur in the spring. I attribute our leakage wholly to the mains. I think I have spent more money in putting in new meters than anything else, and, I tell you, it pays.

Mr. Howard—I did not expect to make any remarks, but I will give you my experience in regard to exhausters. I had been running an old exhauster and four or five months ago I was in a quandary to know what kind of an exhauster to put in. My predilection was for a jet exhauster, but I had an impression that it caused naphthaline. I corresponded a good deal with parties who were using jet exhausters. Some said they had been using them for a long time and never had any naphthaline, others said they had been using them and had to give them up because they had naphthaline; and the difference between them was so great in regard to the use of jet or rotary exhausters that I thought I would give the jet exhauster a trial. The parties who manufactured it gave me to understand that there would be no trouble from naphthaline. Upon that understanding I ordered one and set it up in my retort house. All my pipe run underground to the purifying house, outside of the retort house, 80 feet; there it goes into the combined washer, as they call it. From there it goes into the pipe condensers, consisting of about 20 eight-inch pipes; from there it passes into the scrubber, and from the scrubber into what we call the dry scrubber, made of an old wet lime washer. I got my exhauster up, set it to work, and for a couple of weeks I found no trace of naphthaline, and I was congratulating myself upon not having any. But one day I had a stoppage. I went to work and ran steam in, and finally cleared it, but I had considerable trouble in taking care of it. Where the naphthaline forms is immediately after leaving this combined washer, and when it is going to the pipe condensers. I had apprehensions that it would take place in the pipe, leading underground; but it never will take place there, on account of the gas remaining cold, while in the combined washer it is very warm; so that I have no apprehensions that naphthaline ever forms outside.

In order to take care of the naphthaline I had sheet iron boxes made, 8 feet long, 8 inches wide, and 15 inches deep, that the pipe condenser is set on; I had a 1½-inch pipe tapped underneath that; I brought that out 10 inches, leading into the straight pipe running into the sheet iron boxes. There were 8 of them. I drilled that for a 1½-inch pipe, running that pipe down into the sheet iron box, so that in case the first pipe should stop up at any time there would be considerable leeway left to come out by the other pipe without having any stoppage. After I got it all in I had a stoppage in about 5 days. I then had considerable trouble in regard to taking care of it. To make assurance doubly sure, I erected steam pipes in every third box; for instance, the 1st, 3d, and 5th boxes, running down, connecting with the cast iron boxes. I then ran the steam pipe into the sheet iron boxes and cleaned them out; and I presume I can run now for 8 days without any trouble. In order to clean it out I heat the box as hot as I can get it with the steam pipe; I then turn the steam in on the condensers—the first two boxes, the first two steam outlets—and steam them for about half an hour. The naphthaline liquifies with the steam as it goes into the drip pipes leading down, and as the water is extremely hot, it goes down into the pipes and bubbles up into the tank, and there solidifies. I have an iron shovel with holes in the bottom that will fit into that box, and there I scoop the naphthaline out. I can run the exhauster with perfect satisfaction now, and can take care of the naphthaline and have no trouble with it. I intend to utilize what naphthaline I get in the future. Some time ago I met my friend Smith and asked him what use I could make of it, and he said, "Put it into your retort again and convert it into gas;" and as I have 3 barrels of it stored, I intend when I go back to make it into gas.

I will state that, as far as the jet exhauster is concerned, I prefer it in small works to a rotary exhauster. It is better on account of its simplicity, especially where you have men that you would not trust an engine to. It requires hardly any attention, provided you keep the water in the governor at the proper level. That is about all the attention it requires; it regulates itself. I have never had any trouble with mine. The men in the retort house are perfectly taken up with it, and I believe they would cry it I were to take it away.

In regard to the yield I have had with and without an exhauster, I will give you my experience. Before I had an exhauster my average run was possibly in the neighborhood of 4.70 or thereabout; since I have been using an exhauster it has been, with the addition of 3 or 4 per cent. of cannel coal which I use, from 5.3 to 5.5, right along. The fuel that I use for the running of the boiler amounts to almost nothing. I do not use any coal; I use nothing but the remnant of the yard which would be naturally thrown away. I use nothing but breeze and the scorings of the mouthpieces of the retorts in discharging.

In regard to the boilers, I would advise everybody when he puts in a boiler to put in a large one. You will find that there is economy in having a large boiler. If you have a good fire surface you can burn anything. I think my boiler cost $425; it was manufactured by the ——— Manufacturing Company, and I feel highly pleased with it. The carbon in my retorts is greatly diminished since I have had it. It will make 200,000 feet a day, and the only skill required to run it is to put a little fire under the boiler and turn the valve to let the water into the boiler. In running a rotary engine in small works it requires some mechanical knowledge, in case anything should get out of order.

There is no wear and tear with the jet exhauster that I can see, but there is one thing that has to be looked out for, and that is naphthaline. If you can take care of the naphthaline you are all right.

Mr. King (Jacksonville, Ill.)—About five years ago we put in a rotary exhauster, and we have have never had any trouble with it to this day, except tLat once, I believe, the eccentric had to be taken to the machine shop. Our ordinary laborers took care of it. With one man on watch we make a minimum of 20,000 feet and a maximum of 60,000 feet. We have never had any naphthaline or any wear and tear. It takes about 25 minutes every morning to give it a thorough oiling, and then it requires no more attention during the day.

Mr. Howard—I could not get a rotary exhauster and engine combined for my works for less than $1,000 or $1,1000, and all a jet exhauster costs is about $370. That shows the difference between the cost of the two. With the rotary, someone has to look after the engine every once in a while, and it has to be oiled. We do not have to oil the jet exhauster except, perhaps, once in two months. and we have to go once in eight days to look after the stuffing box.

Mr. Lansden—I think a jet exhauster can be used without forming naphthaline.

Mr. Howard—I would like to know of some way of preventing the formation of naphthaline in my gas.

The President—Use a rotary exhauster.

Mr. Howard—I would rather have the trouble of cleaning once in eight days and have a jet exhauster.

Mr. Watts—I have been running a jet exhauster at San Antonia, Texas, for over a year, and have had no trouble at all with naphthaline.

Mr. Howard—I had no naphthaline when I was running with Illinois coal; but I got out of Illinois coal this winter on account of the blockade, and then I had naphthaline. It may be that naphthaline is caused by the coal used.

Mr. Watts—We are using Indian Nation coal at San Antonio.

Mr. Starr—I used a jet exhauster because it was said to prevent naphthaline. I now use a rotary; in 1865 I put in my first exhauster, and I have never regretted it from that day to this.

Mr. Howard—When I go home I am going to try the experiment of arranging the temperatures of the condensers, so as to see if I cannot do away with naphthaline by regulating the temperature. It may be possible that that will obviate the difficulty.

Mr. Lansden—I think Mr. Howard is right; I believe the formation of naphthaline is not owing to the use of a jet or a rotary exhauster, but to temperature. I have adopted the plan of having thermometers where the gas leaves the hydraulic main, and I have had no trouble with naphthaline since I have done so. I think it is owing to the shocking of the gas at some point where the temperature is too low.

Mr. Smith (Grand Rapids)—I think, from my experience with naphthaline, that it is owing to temperature more than to anything else.

Mr. Moran (Joliet, Ill.)—I have run a jet exhauster for nearly 7 years, and never ran short of 40 pounds of steam, and I cannot charge two benches together; if I do, it is the same as if I had no exhauster at all. I have to wait an hour, until one bench is pretty well burnt, and then charge another bench. But we are never bothered with naphthaline. Our works have been running for 20 years, and I do not know what it is.

The President—As regards the jet and rotary exhauster, it is a matter of taste; but I question whether it is not bad policy to throw hot steam in your gas.

Mr. Munzinger—When we used retorts having a temperature of 1400° or 1500° we never knew such a thing as naphthaline; but now that we have retorts running up to 2200° and 2300° F., we have naphthaline. In order to use the steam jet exhauster, you have to have a multitubular water condenser. If you have not got that, you had better let steam alone.

Mr. Judge (Rock Island, Ill.)—We have used our exhausters ever since the works commenced, about 8 years ago, and since we purchased the works, about 4 years ago, we have run continually, with the exception of two or three months last summer, when I found it profitable to discontinue. We had more retort capacity than was necessary. I found that 5 to 10 per cent. was all we could gain by using the exhauster, and that it would cost us $15 a month to run it; so we discontinued it during part of June, July, and August. I am not running my exhauster now, and do not intend to before next fall. I think it would average about $10 a month for coal to run the exhauster, and oil and tallow would amount to a least $2 a month.

On motion, a committee of three, consisting of T. G. Lansden, Sylvester Watts, and J. B. Howard, was appointed to correspond with the different gas companies of the country, for the purpose of ascertaining if they would contribute toward a prize to be offered for the best invention of a gas engine.

The Convention then adjourned until to-morrow morning at 8 o'clock.

Morning Session—May 13.

Called to orded at 8:30 A.M., the President in the chair.

The following resolution was unanimously adopted:

Resolved, That the thanks of this Association be and they are hereby tendered to the several railroad companies for their courtesy in making reduced rates for return of the members of this Association.

In accordance with the invitation, the Association then proceeded to inspect the works of Messrs. Shickle, Harrison & Co., Parker, Russel, & Co., Evans & Howard, and the Laclede Fire Brick Manufacturing Co., where they were courteously received and afforded every facility to examine their several operations.

The Association then proceeded to the Fair Grounds, where an elegant lunch had been provided by the St. Louis Gas Light Company and the Laclede Gas Light Company, to which ample justice was done by all present, and the Secretary authorized to make due acknowledgements therefor.

The Association then adjourned to meet in Chicago in May, 1882.

Thomas Butterworth, *President*

L. A. Hall, *Secretary*

The Storage of Electricity.

The London *Times* prints the following letter to the editor of that journal:

"Sir:—Although agreeing with every word of Sir William Thomson's letter in the *Times* of to-day, and entirely sympathizing with his enthusiasm as regards the marvellous box of electricity, still I feel that it would have been desirable if in pointing out the importance of this new discovery Sir William Thomson had guarded against a very probable misconstruction of the purport of his letter.

"The means of storing and re-storing mechanical energy form the aspiration of not only Sir William, but of every educated mechanic. It is, however, a question of degree—of the amount of energy stored as compared with the weight of the reservoir, the standard of comparison being coal and corn. Looked at in this way, one cannot but ask whether, if this form of storage is to be the realization of our aspirations, it is not completely disappointing. Large numbers are apt to create a wrong impression until we inquire what is the unit. Eleven million foot-pounds of energy is what is stored in one pound of ordinary coal. So that in this box, weighing 75 pounds, there was just as much energy as in 1¼ ounces of coal, which might have been brought from Paris or anywhere else in a waistcoat pocket, or have been sent by letter.

"When we come to the question of the actual conveyance of energy for mechanical purposes, this view is of fundamental importance. The weight of the same amount of energy in this new form is 800 times greater than the equivalent amount of coal; and as a matter of economy, supposing that energy in this form might be had at a certain spot and no capital were required for its conversion or storage, and that the energy were directly applicable, it could not be carried 10 miles—that is to say, such energy cannot be economically useful 10 miles from its source, although coal had to be carried 100 miles to the spot. This limit, in truth, falls far short of what has been already attained by other means. By wire ropes and by compressed air or steam energy may be economically transmitted from ten to twenty miles. So that if this is the utmost of what is to be done by means of the storage of electricity, this discovery adds another door to those which are hopelessly closed against the possibility of finding in Niagara or other water power a substitute for our coal, even when the object is motive power, and much more for that purpose for which five-sixths of our coal is used—the production of heat.

"It is very important that the people of this country should not shut their eyes to the fact that so far from there being a greater prospect of the solution of the problem than when, about twenty years ago, Professor Jevons raised the alarm, the prospect is now much smaller. In the meantime the capabilities of steel ropes, fluids in pipes, and electricity along conductors have been not only investigated, but practically tested and found altogether wanting. And now it would seem that the storage of electricity must be added to the list. Osborne Reynolds.

"Owens College, June 9."

Effect of Electric Light on the Eyes.

An unexplained objection to the electric light arises from its alleged evil effects on the eyes. European observers state that the frequent variations in intensity to which the light is subject give rise to sudden and frequent changes in the pupil, and, consequently, in the "accommodation" of the eye, by which is meant that alternate contraction and dilation of the pupil, by which it suits itself to the variations of light. Such a light, therefore, causes not only muscular fatigue, but also a considerable degree of blurring and indistinctness in the retinal image. The eye suffers both when the

light is too dim and when it is too bright. In the former case the object must be brought close to be clearly seen, and an increased accommodative effort is called for, which in most cases results in nearsightedness. In the latter case, the simple intensity of the light produces undue contraction of the pupil, and an increase of tension within the eye.—*Manufacturer and Builder.*

[Read at the Birmingham Meeting of the British Association of Gas Managers, June 14th.]

On Gas Supply, both for Heating and Illuminating Purposes.

By C. W. Siemens, C.E., D.C.L., F.R.S.

[We are indebted to Walter King, Esq., of the London *Journal of Gas Lighting*, for advance proof sheets of Dr. Siemens's Paper.—Ed.]

When, within the memory of living men, the gas burner took the place of the time-honored oil-lamp, the improvement, both as regards the brilliancy of the light and the convenience of the user, was so great that the ultimate condition of perfection appeared to have been reached. Nothing apparently remained for the engineer to effect but improvements in the details of the works and apparatus, so that this great boon of modern times might be utilized to the largest extent. It is only in recent years that much attention has been bestowed upon the utilization of bye-products, with a view of cheapening the cost of the production of the gas, and that the consumer has become alive to the importance of having a gas of high illuminating power, free from nauseous constituents, such as bisulphide of carbon; thus providing a gentle stimulant for steady progress on the part of the gas works manager.

This condition of steadiness and comfort has been somewhat rudely shaken by the introduction, within the last year or two, of the electric light, which, owing to its greater brilliancy and cheapness, threatens to do for gas what gas did for oil half a century before. The lighting of the City of London, and of many public halls and works, furnishes indisputable proof that the electric light is not an imaginary, but a real and formidable competitor with gas as an illuminant; and it is indeed time for gas managers and engineers to look seriously to their position with regard to this new rival—to decide whether to meet it as a foe, and contest its progress inch by inch, or to accept at once the new condition of things, conceding the ground that cannot reasonably be maintained, and to look about in search of such compensating fields as may be discovered, for a continuation or extension of their labors.

For my own part I present myself before you both as a rival and a friend; as a rival, because I am one of the promoters of electric illumination; and as a friend, because I have advocated and extended the use of gas for heating purposes during the last twenty years, and am by no means disposed to relinquish my advocacy of gas both as an illuminating and as a heating agent. Speaking as a gas engineer, I should be rather disposed to regard the electric light as a welcome incentive to fresh exertion, confidently anticipating achievements by the use of gas which probably would have been long postponed under the continued *regime* of a monopoly. Already we observe, both in our thoroughfares and in our apartments, gas burners producing a brighter and more powerful light than was to be seen previously; and although gas will have to yield to electric light the illumination of our lighthouses, halls, and great thoroughfares, it will be in a position, I believe, to hold its own as a domestic illuminant, owing to its great convenience of usage, and to the facility with which it can be subdivided and regulated. The loss which it is likely to sustain in large appliances as an illuminant would be more than compensated by its use as a heating agent, to which the attention of both the producer and consumer has latterly been largely directed.

Having, in the development of the regenerative gas furnace, had exceptional opportunities of recognizing the many advantages of gaseous over solid fuel, I ventured, as early as 1863, to propose to the Town Council of Birmingham the establishment of works for the distribution of heating gas throughout the town; and it has occurred to me to take this opportunity (when the Gas Managers of Great Britain hold their annual meeting at the very place of my early proposal) to lay before them the idea that then guided me, and to suggest a plan of operation for its realization, which at the present day will not, I venture to hope, be regarded by them as utopian.

The proposal of 1863 consisted in the establishment of separate mains for the distribution of heating gas to be produced in vertical retorts, that might be shortly described as Appold's coke ovens heated by means of "producer" gas and "regenerators." The heat of the retorts was to be increased beyond the ordinary limit, in order to produce a coke suitable for locomotive and other purposes; and the gas produced being possessed of less illuminating but of the same heating power, and being, with a view to cheapness, less thoroughly purified than ordinary retort gas, was to be distributed through the town as a heating agent, to be applied to the small boilers and furnaces of the numerous little factories peculiar to the district, as well as for domestic purposes. The Corporation applied for an Act of Parliament, but did not succeed in obtaining it, owing to the opposition of the existing gas companies, who pledged themselves to carry out such an undertaking if found feasible by them. I am ready to admit that at the time in question the success of the undertaking would have involved considerable practical difficulty; but I feel confident that the modified plan which it is my present object to bring before you would reduce these difficulties to a minimum, and open out, on the other hand, a field of vast proportions, for the enterprise and energy of those interested in gas works, and of great benefit to the public.

The gas retort would be the same as at present, and the only change I would advocate in the benches is the use of the regenerative gas furnace. This was first successfully introduced by me at the Paris Gas Works, in 1861, and has since found favor with the managers of gas works abroad and in this country. The advantages that have been proved in favor of this mode of heating are—economy of fuel; greater durability of retorts, owing to the more perfect distribution of heat; the introduction of an additional retort in each bed, in the position previously occupied by the fire-grate; and, above all, a more rapid distillation of the coal, resulting in charges of four hours each, whereas six hours are necessary under the ordinary mode of firing.

The additional suggestion I have now to make consists in providing over each bench of retorts two collecting pipes, the one being set aside for illuminating, and the other for a separate service of heating gas. I shall be able to prove to you, from unimpeachable evidence, that the gas coming from a retort varies greatly in its character during progressive periods of the charge; that during the first quarter of an hour after closing the retort the gas given off consists principally of marsh gas (CH_4) and other occluded gases and vapors, which are of little or no use for illuminating purposes; from the end of the first quarter of an hour, for a period of two hours, rich hydrocarbons, such as acetylene (C_2H_2) and olefiant gas (C_2H_4) are given off; whereas the gases passing away after this consist for the most part again of marsh gas, possessing low illuminating power.

M. Ellissen, the late chief of the experimental department of the Paris Gas Works, and actual President of the French Society of Gas Engineers, has favored me with the result of a most interesting series of experiments, which he carried out in connection with the late M. Regnault, the eminent physicist, some years ago; the object of the experiments being to discover the proper period of time to be allowed for each charge. The accompanying diagram gives the result of these experiments (see Appendix), showing in a striking manner that although the average illuminating power produced by the distillation of the coal did not exceed 1.35 Carcel burners, or 13.5 standard candles, according to our English mode of measurement, the gas given off from the end of the first quarter of an hour, during a period of two hours, possessed an illuminating power of 1.616 Carcel burners, or 16.16 standard candles.

According to the figures given in the valuable experiments of M. Ellissen it appears that nearly two-thirds of the total production of gas takes place in the above period, whilst the remaining third is distilled during the first quarter of an hour and the last hour and three-quarters. It hence follows that by changing the direction of the flow of gas at the periods indicated, allowing the first results of distillation to flow into the heating gas main, then for two consecutive hours into the illuminating gas main, one-third of volume heating and two-thirds of illuminating gas would be obtained, with this important difference, that the illuminating gas would be of 16.16 instead of 13.5 candle power, and that the heating gas, although possessed of an illuminating power of 11.05 candles, would be preferable to the mixed gas for heating purposes, in being less liable in its combustion to deposit soot upon heat-absorbing surfaces, and in giving, weight for weight, a calorific power superior to olefiant gas.

These experiments not having been made for the particular objects I have in view, no account was taken of the quantity or quality of the gas coming from the retort during the first quarter of an hour. Judging by the nature of the curves given by M. Ellissen, it is reasonable to suppose that during the first quarter of an hour a considerable quantity of gas of very inferior illuminating power is given off, which, if taken into account would further improve the result given in favor of separating the illuminating from the heating gases.

It will be observed that although the candle power of the illuminating gas would be raised to only 16.25, if two-thirds of the gas were set apart for this purpose—*i.e.*, after the first 25 minutes of distillation up to 2 hours 35 minutes from the commencement of the charge—a gas equal to 18.04 candles could be obtained if the proportionate quantity of heating and illuminating gas were reversed, which might be effected by continuing the distillation for illuminating purposes from 25 minutes to one hour 27 minutes after the commencement of the charge; whilst, if equal quantities of heating and illuminating gas were produced, which would result from allowing the illuminating gas to flow into its receiver from 25 minutes to two hours, the can-

dle power of this portion of the gas would be raised to 16.78, as shown in the figures given below—

Total gas produced from a ton of coal, 10,573.20 *cubic feet, of* 13.50 *candle power.*

	Illuminating Gas. Cub. F.	Candle Power.	Heating Gas. Cub. Ft.
Illuminating gas passing into its main 25 minutes after commencent of charge:			
If two-thirds of quantity is used for illumination, from 25 minutes to 2h. 35m....	7048.8	16.25	3524.4
If half of quantity is used for illumination, from 25 minutes to 2 hours.....	5286.6	16.78	5286.6
If one-third of quantity is used for illumination, from 25m. to 1h. 27m.....	3524.4	18.04	7048.8

These important results are borne out by a series of photometric observations which were made some years ago by Mr. Sugg, which he has further supplemented verbally in stating that the average illuminating power obtained by the distillation of Newcastle coal might be taken at 14-candle power, whilst two-thirds of the quantity, if separated in the manner I propose, would produce an average of 16 candles.

The working out of this plan would involve the mechanical operation of changing the direction of the gas coming from each bench of retorts at the proper periods of the charge. This could be accomplished by means of a simple reversing valve, similar to that applied for many years in reversing the current of the regenerative gas furnace, and a sand-glass may be placed in front of each bench of retorts, for the guidance of the man in charge as to the time when the reversal should be made. In order to distribute the two gases a double set of gas mains certainly would be required; but these exist already in the principal thoroughfares of many of our great towns, where, at one period or another, competing gas works have been established, and it would not, I think, be difficult to utilize these services for the separate supply of illuminating and heating gas, the latter being taken into the houses and establishments only where it was asked for by the occupiers.

The public could well afford to pay an increased price for a gas of greatly increased illuminating power, and the increase of revenue thus produced would enable the gas companies to supply heating gas at a proportionately reduced rate. It would not be necessary to employ upon the heating gas the same expense and trouble in purification as is required for illuminating gas, because the products of combustion of the heating gas would not, as a rule, enter the apartments, but be conducted into the atmosphere through the ordinary chimneys. Heating the retorts by means of the regenerative gas furnace would, as already indicated, lead to an increased production of gas from each bench of retorts, and thus compensate for the reduced amount of illuminating gas in each operation. The heating gas might, without inconvenience, be sent through the pipes at a greater pressure than the illuminating gas, in order to make a given size of mains transmit an increased quantity.

The question may be fairly asked, whether a demand would be likely to arise for heating gas similar in amount to that for illuminating gas; and I may state that I am decidedly of opinion that although at the present moment the amount of gas supplied for illuminating purposes exceeds that for heating, the diminution in price of the latter would very speedily indeed reverse these proportions. Already gas is used in rapidly increasing quantities for kitcheners, for the working of gas engines, and for fire-grates. As regards the latter application, I may here mention that an arrangement for using gas and coke jointly in an open fire place combined with an exceedingly simple contrivance with a view of effecting the combustion of gas by heated air, has found favor with many of the leading grate builders and with the public. Although this arrangement was suggested by me only last winter, several hundred of these grates are already in use in London, Manchester, Leeds, Glasgow, and other towns, showing how fully alive the public are at the present time to that great crying evil, "the smoke nuisance." It may be as well for me to mention here, that neither the regenerative gas coke fire-grate just alluded to, nor the plan I here advocate of separating the produce of gas retorts, has been made by me the subject of letters patent; my time being already too much occupied in other directions to give that amount of constant attention to these subjects which the working of a patent necessitates.

As regards the use of illuminating gas, I have one more suggestion to make, which I feel confident will be viewed by you not without interest. The illuminating effect produced in a gas flame depends partly upon the amount of carbon developed in the solid condition in the body of the flame, and partly upon the the temperature to which these particles are heated in the act of combustion. Having already shown how, by separation, a gas of greater luminosity may be supplied, it remains to be seen how the temperature of combustion may be raised. This may be effected to an extent that seems surprising, by certain mechanical arrangements, whereby a portion of the waste heat produced by the flame itself is rendered available to heat the gas and air sustaining the combustion of the flame, say to 600°F., or even beyond this point.

The arrangement I have adopted for this purpose is represented on the sectional diagram, and I have also the pleasure of placing the burner itself before you, to enable you to test its efficiency by actual trial. The burner is of the ordinary Argand type, mounted in a small cylindrical chamber of sheet copper, connected with a vertical rod of copper, projecting upwards from it in a rounded and pointed form. The copper vessel surrounding the burner is contracted at its upper extremity, with a view of directing a current of air against the gas-jets on the burner, and on its circumference it is perforated for the admission of atmospheric air. The bottom surface is formed of a perforated disc covered with wire gauze, and wire gauze also surrounds the circumference of the perforated cylinder. The external air is heated in passing through these "regenerative" surfaces, and the flame is thus fed with air heated to the point above indicated, which by more elaborate arrangements might be raised to a still higher degree. The ball of fireclay, in the center of the burner, which is heated to redness, serves the useful purpose of completing the combustion of the gas, and thus diminishes the liability to blackening of the ceiling.

The arrangement for transferring the heat from the tip of the flame to the air supporting its combustion is also applicable to an open batswing burner; but I have not yet had time to ascertain accurately the amount of increase of luminosity that may be realized with this class of burner.

I may here mention that another solution of the problem of heating the incoming air by the waste heat of the products of combustion has lately been brought under public notice by my brother, Frederick Siemens, which differs essentially from the plan I have suggested, inasmuch as he draws the flame downwards through heating apparatus, and thence into a chimney. Experiments made officially and with great care have proved that by these methods the luminous effect of gas can be practically doubled. In practice both these methods of intensifying a gas flame will probably find independent application according to circumstances, the cause of increased luminous effect being in both cases the same.

From a purely theoretical point of view it can be shown that of the caloric energy developed in the combustion of gas, a proportion, probably not exceeding one per cent., is really utilized in the production of luminous rays; and that even in the electric light nine-tenths of the energy set up in the electric arc is dispersed in the form of heat, and one-tenth only is utilized in the form of luminous rays. It would lead us too far here to go into the particulars of these calculations, but it is important to call attention to them in order to show the large margin still before us for practical improvements.

By the combined employment of the process for separating the illuminating from the heating gas with the arrangement for intensifying the luminosity of the gas flame previously described, the total luminous effect produced by a given consumption of coal gas may, according to the figures given, be increased threefold; thus showing that the deleterious effects now appertaining to gas illumination are not inseparably connected with its use.

My principal object in preparing this communication has been to call your attention generally to the important question of an improved gas illumination, and more particularly to the subject of a separate supply for heating gas, which, if carried into effect, would lead, I am convinced, to beneficial results, the importance of which, both to gas companies and to the public, it would be difficult to over-estimate.

APPENDIX.

"PARIS, June 4, 1881.

"Dear Sir—I send you herewith the results of my experiments, together with tables and curves. The very ingenious proposal that you have made would permit such a division of the total production of gas, that two-thirds could be employed for lighting and one-third for heating purposes, resulting in splendid illumination and much more rational heating.

"I am dear Sir, etc.,

[Signed] "A. ELLISSEN.

"Dr. C. William Siemens."

"*Experiments on the Variation of Production of Gas, and of its Illuminating Power, at Different Periods of the Distillation.*

"Tables I. and II. contain the results of experiments made in a bench of seven retorts, of the type of the Compagnie Parisienne, each retort being charged respectively with 100, 110, and 120 kilogrammes (220 lbs., 242 lbs., and 264 lbs.).

Table I. corresponds to a distillation of 4 h. 00m.
Table II. " " " 4 h. 48m.

The period of distillation has been divided into intervals of 15 minutes, and the results recorded on each horizontal line refer to the gas produced during the quarter ending the time mentioned on each line.

"In each of the two tables the case of a charge of 110 kilos. (242 lbs.) has been chosen as the standard, and the results have been graphically repre-

sented by means of two curves, one in red for the gas produced, and the other in blue for the illuminating power. The line of abscissæ being divided into equal parts, each representing 15 minutes, each ordinate of the red curve gives the gas produced during the preceding quarter of an hour, and the corresponding ordinate of the blue curve indicates the illuminating power of this same gas. The production of the gas has been further divided into two portions—the one destined for illumination, and the other for heating and motive power.

"The gas produced during the first quarter of an hour is generally of low illuminating power, and varies beside with the hygrometric condition of the coal. In the following calculation it has been accordingly classed with the heating gas, and the gas produced during the interval from 15 m. to 2 h. 15 m. of the working has alone been reserved for illuminating purposes—

I.—*Distillation in Four Hours—Charge*, 110 *kilos.* (242 *lbs.*)

I. Gas produced per 100 kilos. of coal distilled—

	Cubic Meters.	Per Ton. Cubic Feet.
1. From 15 m. to 2 h. 15m	18.062	6502.32
2. From 0 m. to 0 h.15m. and from 2h.15m. to 4h.	11.308	4070.88
Total	29.370	10573.20

II. Gas produced per 100 cubic meters obtained—

	Cubic Meters.
1. From 15m. to 2h. 15m	61.502
2. From 0m. to 0h. 15m. and from 2h. 15m. to 4h	38.498
Total	100.000

III. Mean illuminating power of the produced gas—

	Litres.	In English Std. C'dles.
1. From 15m. to 2h. 15m	87.7	16.16
2. From 0m. to 0h. 15m. and from 2h. 15m. to 4h	128.2	11.05
Mean of the total mixed gas as per calculation	103.3	—
Illuminating power of mixed gas as per direct trial	105.7	13.50

II.—*Distillation in 4h. 48m.—Charge*, 110 *kilos.* (242 *lbs.*)

I. Gas produced per 100 kilos. of coal distilled—

	Cubic Meters.	Per Ton. Cub. Feet.
1. From 15m. to 2h. 15m	20.388	7339.68
2. From 0m. to 0h.15m. and from 2h.15m. to 4h.48m	9.741	3506.76
Total	30.129	10846.44

II. Gas produced per 100 cubic meters obtained—

	Cubic Meters.
1. From 15m. to 2h.15m	67.673
2. From 0m. to 0h.45m. and from 2h.15m. to 4h. 48m	32.327
Total	100.000

III. Mean illuminating power of the produced gas—

	Litres.	In English Stnd. Cdls.
1. From 15m. to 2h. 15m	101.1	14.02
2. From 0m. to 0h. 15m., and from 2h. 15m. to 4h. 48m	132.4	10.07
Mean of the total mixed gas	111.2	12.77

"It is not proposed to stop at the results obtained by distillation in 4h. 48m.—that is, five charges per 24 hours. Experience has proved that the best conditions of working are found in the use of active charges rapidly distilled by raising the temperature of the furnaces.

"From these experiments it results that it would be possible to divide the products of distillation of coal into illuminating gas and gas for heating purposes and motive power. Thus, in place of producing, as is generally done, by means of a distillation of four hours and 110 kilos. (242 lbs.) per retort, a mean result per 100 kilos. of coal distilled of 30 cubic meters of normal gas, which corresponds to an expenditure of 105 litres to produce the light of a Carcel burner consuming 42 grammes of oil per hour, there may be produced—(1st) about 18.5 cubic meters of illuminating gas of an illuminating power of 87 litres; and (2nd) about 11.5 cubic meters of heating and motive power gas of an illuminating power of 128 litres; or, per 100 cubic meters of gas produced, 61.50 cubic meters of illuminating gas, and 38.50 cubic meters of heating and motive power gas.

"This result would be obtained by receiving into separate reservoirs the gas produced during the first 15 minutes, and during the last 1h. 45m. of the distillation, and in reserving for illuminating purposes the gas made in the interval of 15m. to 2h. 15m. of the charge from the commencement of the distillation. [Signed] "A. Ellissen.

"Paris, *June* 4, 1881."

The Brush Light and the London Gas Company.

It is said that the directors of the Brush company have found by experience that the absolute continuity of their light cannot be relied upon, and that from some cause or other it is liable to cease suddenly. The effect of such a collapse in the streets of London would be extremely serious, and would be followed by a similar collapse in the shares of the electric light companies, and notably in those of the Brush, which stand at present at over 100 per cent. premium—that is to say, the £10 shares, on which £4 are paid, are quoted at £8 10s. to £9.

To guard against this disaster, the directors of the Brush company communicated, it is said, with the board of the gas company, and an arrangement was finally made that the gas company should keep up a full staff of men at all points served by the Brush company, and a full supply of gas at the mains ready to light up at any moment that the electricity might fail, all the expense of the staff and the reserved gas to be borne, of course, by the Brush company. The significant part of the business is that the gas company should thus stand by to assist the rival company, instead of leaving it to its own resources, and to bear the brunt of its own failure, should it fail.

Philanthropy is not supposed to enter into the considerations by which companies are managed, and it must be assumed that, if this rumor is correct, the gas company is so completely assured of the ultimate breakdown of its rival that it can, in the interests of the public, and at the expense of the said rival, afford to be magnanimous.—*Vanity Fair.*

Mains and Pipes.

A NEW MODE OF MANUFACTURE.

The development of gas lighting, and the improved sanitary condition of civilized countries have, during the past few years, caused a great demand for gas and water pipes; and great improvements have been made in them. It is somewhat singular, however, that little progress has been made in this country towards the adoption of wrought-iron pipes, or pipes made in a form so much lighter and portable than in cast iron. We believe that some years ago the Paris gas company laid down a large main, as an experiment, with pipes made from sheet iron from two to three feet diameter, which were a success, and those laid by them since have likewise proved satisfactory. In this country, however, cast iron pipes have hitherto held the sway, and doubtless have been found to do so deservedly. We have, however, had an opportunity recently of seeing the manufacture of various sizes of pipes on an entirely new principle, which possesses the merit, not only of originality, but of marvellous advantages over pipes made of cast iron. We refer to the steel and wrought iron pipes as manufactured by Messrs. Exton, Berridge & Partners, Westminster.

This firm are now manufacturing steel pipes and wrought iron pipes made from rolled sheets, and on the occasion of our visit an opportunity was afforded us of viewing the process of manufacturing throughout. The operation, from the heating of the rolled sheets to the intermediate stage of bending to the required curve, is exceedingly brief, whilst the final jointing of the pipes by hydraulic pressure may be said to be even more rapid. By this process pipes may be made of almost any diameter—we believe they are now usually made between five inches and 36 inches diameter—and in thickness varying from one-sixteenth to three-eighths of an inch, according to the purposes for which they are required, and up to twelve feet in length. The steel pipes made by this process are tested to stand an internal pressure of 500 pounds and upwards to the square inch, and, as a matter of course, are exceedingly light.

The same remark may also be applied to the pipes made of wrought iron, which being manufactured from rolled sheets of the best iron to be obtained, in thickness, for a 9-inch pipe, of but one-eighth inch, may readily be understood to be more portable than the same pipe in cast iron. The advantages of these pipes cannot but be manifest, especially where transport, carriage, or other removal of them by road, rail or sea, is necessary.

They are manufactured by special machinery invented for the purpose, which doubtless entailed considerable labor upon the proprietors, and betokens great ingenuity and mechanical skill on the part of the inventor. The firm are now in a position to do an extensive business, and from the evidence before us, possess undoubted opportunities of competing most favorably with other manufacturers of gas, steam and water pipes.—*The Gas Engineer.*

Gas Works Fires.—During the year 1880, according to the figures given in the Official Report to the Governor of the State of Massachusetts, there occurred two fires in the gas works of that State. The total loss occasioned by these two fires amounted to $165. This would appear to be a pretty good showing for an interest which, in 1875, embraced 49 establishments, with a capital of ten millions of dollars, and the value of whose products amounted to considerably over four millions of dollars.

THE AMERICAN
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PROPRIETORS.

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SATURDAY, JULY 2, 1881.

Official Report of Examinations of Gas for three Weeks ending June 25, 1881, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

1881. June	Time of Day at which Test were made.	New York Gas Light Co.	Manhattan Gas-Light Co.	Mutual Gas-Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
		†	*	†	‡	*	†
6	Between 9.30 A.M. and 1 P. M.	25.93	18.58	26.54	24.59	21.18	30.20
7		26.08	20.15	27.77	24.40	19.42	30.55
8		27.75	19.73	25.17	24.73	19.31	30.28
9		25.19	19.47	25.74	26.00	19.37	29.76
10		24.54	18.68	24.93	26.59	19.41	29.53
11		25.96	19.13	26.06	26.08	19.51	29.89
	Average	25.91	19 29	26.03	25.40	19.28	30.12
13		25.97	19.84	24.61	25.18	19.34	29.85
14		27.18	20.42	24.80	24.74	18.86	28.85
15		20.17	18.99	24.38	24.44	19.44	29.19
16		23.59	19.57	26.81	23.92	19.32	29.58
17		24.75	18.71	27.68	23.07	19.51	29.06
18		24.49	18.68	26.55	23.46	19.23	30.40
	Average	24.36	19.37	25 89	24.13	19.28	29.40
20		27.90	19.70	25.79	23.65	19.59	29.85
21		27.90	20.41	25.48	23.49	19 31	29.68
22		27.15	19.28	27.84	22.12	18.15	29.30
23		28.21	19.95	27.97	23.56	18.35	30.18
24		25.64	20.27	28 96	23.23	18.61	30.01
25		24.70	20.46	27.29	23.35	18.94	29.30
	Average	27.05	20.01	27.88	23.23	18.82	29.55

* Five foot lava tip with check.
† Bray's slit union, No. 7.
‡ Bray's slit union, No. 6.

E. G. LOVE, Gas Examiner.

Artesian Wells in New York.

The number of artesian wells in this city steadily and rapidly increases, something like 40 having been sunk during the past year. Their depths range from 200 to 2,000 feet, and the flow ranges from 1,000 to 2,000 barrels a day. These wells are used mainly by brewers and other large manufacturers who require a large amount of water, and who find the artesian well water economical both for its cheapness and its coolness, which enables them to dispense with much ice. Usually the wells are vertical. In one instance seven holes were drilled in different directions and at different angles, only one being vertical. The boring was carried to a depth of about 260 feet on the average, the longest at an angle being 457 feet deep. Water was struck in all the borings, and an abundant supply has been obtained continuously.—*Scientific American.*

Red Lights for Hotel Passages.

The St. Nicholas Hotel, New York, has adopted a feature which is in use in many Western hotels. This is the introduction of red lights in the halls. Firemen say that the greatest difficulty guests experience in a burning building is in finding their way to the stairways. The passages are frequently long and tortuous, and even one quite familiar with their windings is apt to go wrong under the influence of any sudden excitement. For this reason the St. Nicholas has placed red globes on the fixtures in the halls that lead to the staircase, and white lights in those that do not. A stranger can open his door at any hour of the night, and by running along the row of red lights reach the stairs in the shortest possible time.—*Industrial News.*

How to Detect Carbonic Oxide in the Smallest Quantities.

One of the important sanitary problems is to detect in the air of our dwellings very small admixtures of carbonic oxide. The following test, furnished by Vogel, has long been been regarded as the most simple and unfailing: To a flask of water exposed to the air under examination add blood very much diluted. Carbonic acid is shown by the immediate reddening of the mixture. The addition of ammonia sulphide does not banish the absorption lines in the spectroscope as with ordinary diluted blood. The test will show the presence of a portion as small as 0.25 of 1 per cent. Experiments show, however, that the oxide may not all be absorbed in this manner.

Dr. Walter Hempel uses the lungs of living mice to gather the gas from the room. The mouse experimented upon is then drowned, and blood from the region of the heart is tested with fresh, colorless ammonia sulphide. In this way 0.03 of 1 per cent. can be easily detected, and strong symptoms of poisoning are shown with as little as 0.05 of 1 per cent. of the gas. Since carbonic oxide is not, like carbonic acid, an unavoidable ingredient of the atmosphere, it becomes a matter of great importance to determine and prevent its presence.—*Scientific American.*

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
(with W B Scott & Co.,)
34 PINE STREET, NEW YORK CITY.

JULY 2, 1881.

☞ All communciations will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

Gas Co.'s of N. Y. City.	*Capital.*	*Par.*	*Bid.*	*Asked*
Central	$466,000	50	60	65
Harlem	1,800,000	50	82	85
" Bonds	170,000			103
Manhattan	4,000,000	50	195	200
Metropolitan	2,500,000	100	148	—
" Scrip	1,000,000	...	102	103x
Mutual	5,000,000	100	65	70
" Bonds, go'd.	900,000	1000	100	104
Municipal	1,500,000	100	160	165
" Bonds	750,000		106	110
New York	4,000,000	100	100	103
Northern	270,000	50	—	100
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	114	118
Citizens	1,200,000	20	45	50
" S. F. Bonds.	320,000	1000	100	105
Fulton Municipal	1,500,000	100	60	65
Peoples	1,000,000	10	35	40
" Bonds	290,000		101	104
" "	250,000	...	70	75
Metropolitan	1,000,000	100	60	65
Nassau	1,000,000	25	55	60
" Ctfs.	700,000	1000	95	100
Williamsburgh	1,000,000	50	60	65
" Bonds		...	98	103
Kings Co	135,000	100	55	60
" Bonds	40,000	—	—	—
Richmond Co., S. I.	300,000	...	70	75
Out of Town Gas Companies.				
Buffalo Mutual, N.Y	750,000	100	72	76
" Bonds	200,000	1000	95	100
Citizens, Newark	918,000	50	85	90
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			125	—
Cincinnati G. & C. Co.			178	180
Consolidated, Balt.			66	67
Bonds			107	—
East Boston, Mass		25	114	120
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	140	144
Halifax N. S.	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
Jersey City	750,000	20	145	155
Jacksonville, Ill	120,000	50	100	...
Lewistown Maine	400,000	100	—	100
Laclede St Louis Mo.	1,200,000	100	108	110
Montreal, Canada	2,000,000	100	153	154
New Haven, Conn		25	132	—
Oakland, Cal			30	31
Peoples, Jersey City		...	95	100
" " Bds.				5
Pittsfield, Mass			120	130
Rochester, N. Y.		50	70	80
" Citizens		100	30	35
Woonsocket, R. I.	150,000	100	80	...
Wilmington, Del.		50	174	...
Yonkers		50	30	32
Rondout & Kingston			75	80
St. Louis Missouri	600 000	50	250	254
San Francisco Gas-Co., S. Fr'isco Cal.			72	73
Toledo, Ohio			95	97
Troy, Citizens	600,000	100	—	—
Washington, D. C.	1,500,000	20	190	200
" Scrip	500,000	20	150	160

The following stocks were sold at auction, 366 shares of New York, at 98½–100½; 50 Manhattan, at 190; 40 Metropolitan, at 140½.

The Metroplitan Company declare a dividend of 7½ per cent. on stock, and 5 per cent. on scrip, payable August 9th.

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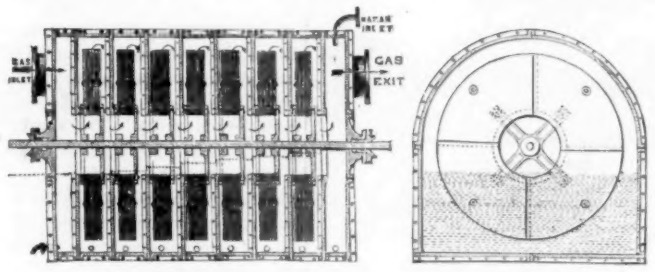

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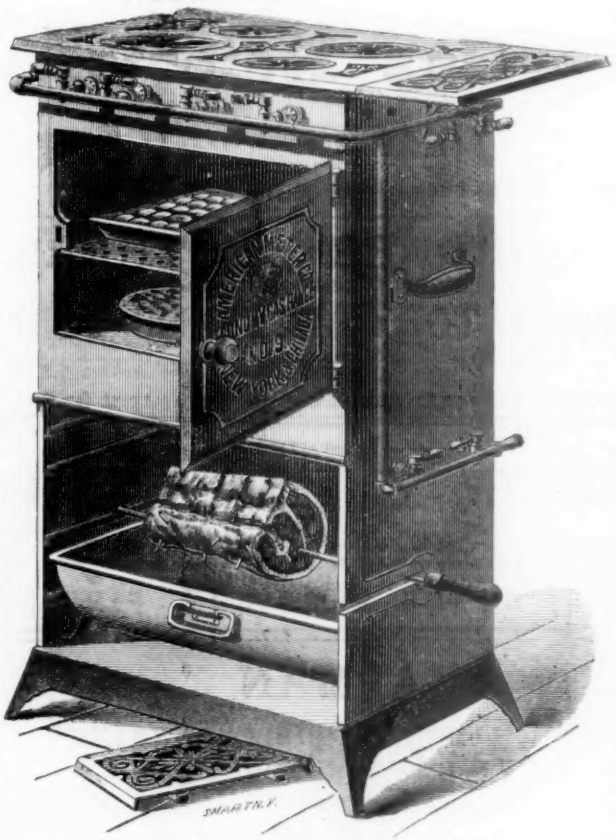

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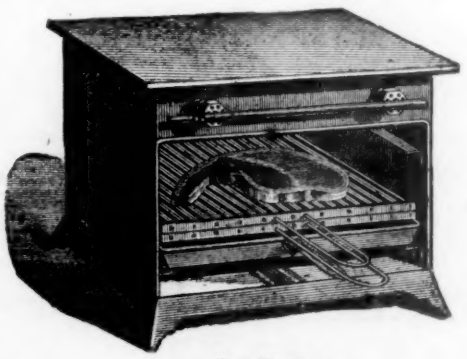

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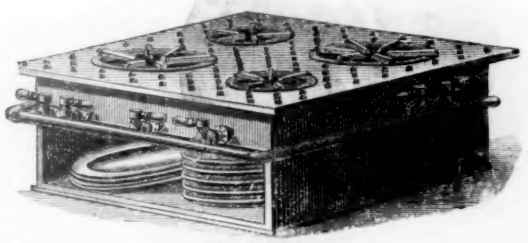

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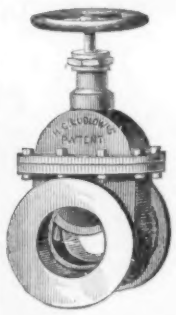

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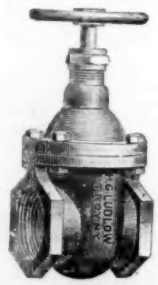

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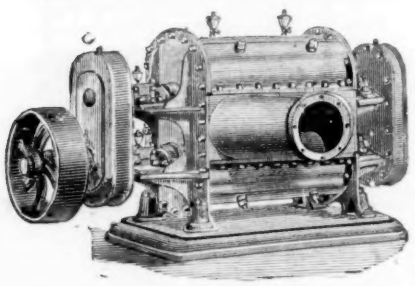

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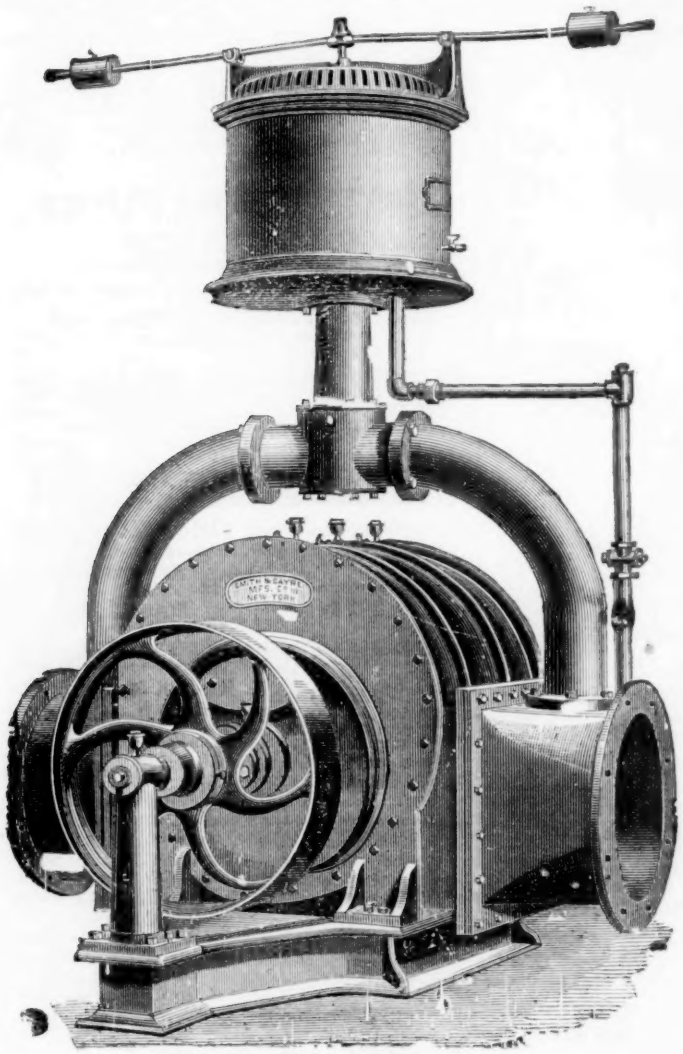

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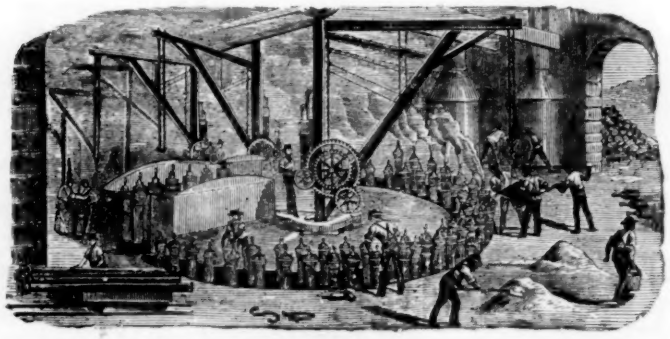

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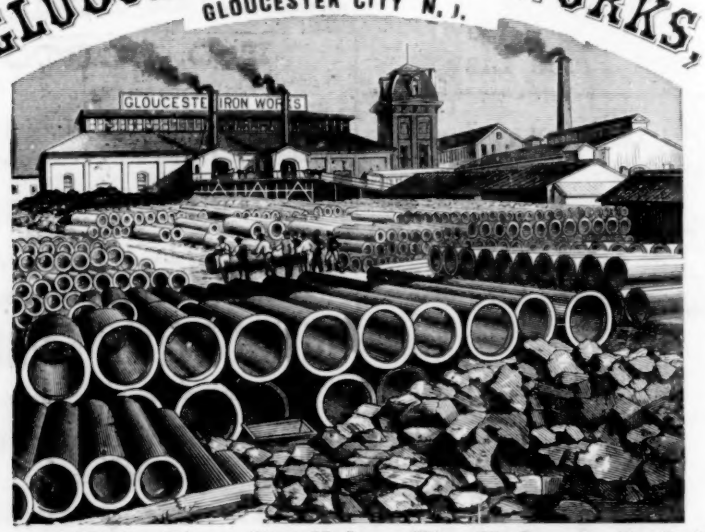

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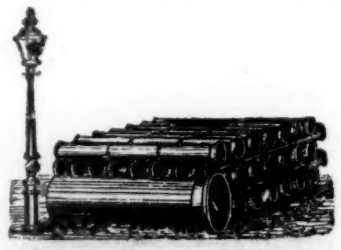

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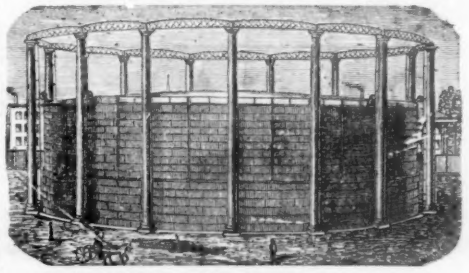

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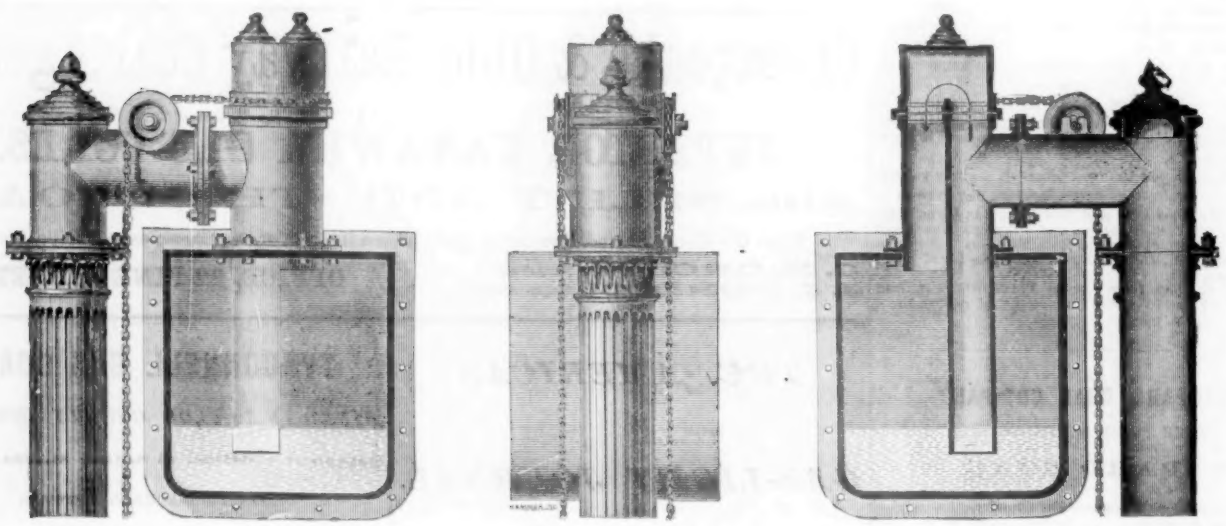

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